THE

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CONTENTS:

	PAGE
The Electrical Engineers' Presidential Address	89
Borchers's Fuel Battery	90
The Christmas Lectures at the Royal Institution	92
The Testing and Inspection of Electric Light Cables.—II. ...	92
On the Thermo-Electric Properties of Platinoid and Manganin	93
The Incandescence Lamp (*illustrated*) (*continued*)	94
Results of the Elihu Thomson Competition	96
Lifting Nature's Veil...	97
Prof. Thompson on the Arc Lamp	97
Correspondence :—	
Muirhead *v.* Commercial Cable Company (*illustrated*) ...	97
Edison Phonograph Motor	98
Local Action in Accumulators...	99
Cost of Working at the Portsmouth Central Station ...	99
Communication with Australasia	99
Notes	100
Business Notices, &c.	103
Contracts Open and Closed	108
City Notes	109
Traffic Receipts	109
Share List of Electrical Companies	110
The Consumption of Alternating Arc Carbons	111
Proceedings of Societies :—	
The Institution of Electrical Engineers	111
The Northern Society of Electrical Engineers	114
New Patents	116
Abstracts of Published Specifications	116

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THE ELECTRICAL ENGINEERS' PRESIDENTIAL ADDRESS.

PERHAPS no previous presidential address has been delivered by a man of more practical experience than Mr. Crompton, and it is not surprising, therefore, that he should confine his speech to the practical questions of the day among electrical engineers.

We have often discussed the points referred to, and on the same lines. As to the load factor, Mr. Crompton has nothing new to advance as a means of improvement, except the introduction of electric heating, cooking, motors, and so on. But these applications would not improve it, for all of them would overlap the lighting supply at the maximum load in winter. Strange that so staunch a friend of the lead accumulator should have nothing to say for storage as a means of levelling the load curve on the generators, for we can hardly expect to level it on the mains. But we must look forward to the use of adequate storage as the only means of overcoming at the generators this drawback to the supply of electrical energy.

Station managers cannot in the least control the load curve; they have absolutely no means provided for the purpose at their disposal. We are, therefore, afraid that but few of them will raise their salaries by depressing the peak, as suggested by Mr. Raworth. The control of the load curve on the mains is beyond their power, and the control of the load curve on the generators can never be seriously attempted until storage has been found successful on a scale far beyond anything hitherto attempted. The station manager who can secure this will at once level his load line, and, no doubt, simultaneously increase his salary.

We have often been struck with the same ideas expressed by Mr. Crompton regarding the qualifications of many of the engineers in whose hands some of the municipal electric lighting schemes are placed. In no other branch of engineering do we find so little practical experience considered necessary in an engineer aspiring to high responsibilities. The warning of Mr. Crompton is timely, for the rapid adoption of electric lighting by municipal bodies spending public money may, instead of being a blessing, become the reverse, particularly if in the course of the next few years, as will probably be the case, it is found that blunders, due to this inexperience, have been committed.

The inexperience of many of the engineers who take up responsible work, accounts for a good deal of the extraordinary differences in prices tendered for work superintended by them. Every manufacturing firm knows to its cost that few consulting and other purchasing engineers can draw up a precise specification of what they want; at any rate it is well known that this is seldom done. What is generally the case is this:—A colliery owner, for instance, consults an engineer of little or no experience on the laying

down of a haulage plant driven by electricity. Does the engineer work out the problems, draw his plans, and make a schedule of what he requires? Oh, no! he simply requests manufacturing firms to send him full particulars and prices, with drawings and plans, for the installation of a complete haulage plant at a certain colliery, and each firm tendering must, of course, guarantee everything. In fact, the engineering of the undertaking and all its responsibilities are saddled on the contractor, and the so-called consulting engineer acts only as a sort of middleman. If he does any consulting, it is to consult the manufacturers as to what machinery and appliances will be required.

How many engineers on electrical works can draw up plans and specifications as a locomotive engineer does for a locomotive, a naval architect for a ship, or an architect for a house. The latter, for example, does not expect the builder to supply him with plans and specifications. Yet that is what engineers in the great majority of cases do with electrical work; the plans, specifications, and drawings, are furnished by the contractor, and the work is merely inspected by the consulting engineer. Thus is "electrical engineering made easy." This practice is pernicious in many ways, and leaves a large opening for divers proposals for the work to be done, and results in the startling differences in prices quoted in tenders, so often commented upon in our pages.

Mr. Crompton's suggestions towards a freer interchange of views and experiences between the young engineers themselves, and between them and the older members, is sound advice. The discussion of actual practice and of difficulties to be overcome, is of far more value than the reading of papers on visionary schemes for levelling the load curve, and such like proposals, which seem to have a peculiar fascination for the aspiring engineer.

BORCHERS'S FUEL BATTERY.

Since we published an account of Dr. Borchers's interesting invention in the Electrical Review, November 23rd, his results have been submitted to experimental test by several persons here, and in America. An American critic asserts that the E.M.F. is not derived from the carbonic oxide at all, but from the action of the chloride of copper on the copper. Of course, in a battery cell with copper and carbon as electrodes, and cuprous chloride as the electrolyte, the copper would be the element dissolved, when it is used in air in the ordinary way. This was foreseen by Dr. Borchers, and he made special experiments to determine whether the result would be different when carbonic oxide was dissolved in the electrolyte in contact with the copper. He found that in this case, instead of the copper being dissolved, there was a slight deposition of copper on the copper electrode. The electrical energy consequently cannot be derived from the consumption of the copper electrode. Another gentleman, Mr. Robert Mond, publishes in a contemporary a series of tests he has made, which appear to by no means agree with Dr. Borchers's results. For instance, he finds that in a cell with carbon in copper oxychloride in H Cl, and copper in cuprous chloride in H Cl, the E.M.F. is 0·4315; when carbonic oxide is dissolved in the cuprous chloride in contact with the copper, the E.M.F. is 0·4407. If these two results are correct, they would show that very little of the E.M.F. in Dr. Borchers's cell was due to the combustible gas. This, however, is not all the difference between Mr. Mond and Dr. Borchers; Mr. Mond describes the copper as the cathode and the carbon as the anode; that is to say, in Mr. Mond's experiments the current entered the cell by the carbon and left it by the copper. Dr. Borchers found the E.M.F. to be 0·4 volt, not so very much different (numerically) from Mr. Mond's result; but, if we mistake not, he found the E.M.F. acting in the opposite direction to what Mr. Mond did, so that the disagreement between Dr. Borchers's and Mr. Mond's results is not the difference of the figures, but their sum. We should not be surprised next to hear from Mr. Mond that, in the Bunsen cell, zinc is the cathode, and carbon the anode. Mr. Mond also gives the results of tests made when both electrodes were carbon. When one carbon was immersed in cuprous chloride in H Cl and air, and the other carbon in cuprous chloride in H Cl and carbonic oxide, the E.M.F. was 0·0015 volt; when coal gas was substituted for carbonic oxide the E.M.F. rose to 0·005. There is a very great disagreement between these results and Dr. Borchers's; but they differ quite as much from some interesting tests described by Mr. W. Tatlow, of Dublin, given in the same contemporary of last week. Mr. Tatlow started with his cuprous chloride already oxidised to cupric chloride in the air compartment of the cell; with this alone he obtained an E.M.F. of 0·2 volt, and when coal gas was led into the cuprous chloride compartment, the E.M.F. rose to 0·36. Mr. Tatlow's results are in remarkably good agreement with Dr. Borchers's, when we allow for difference in the conditions of the experiments. The practical utility of Dr. Borchers's invention has yet to be proved; but, as yet, we think, it has not been seriously damaged by his hostile critics. It is not to be expected that a discovery which has been received with enthusiasm in Germany, by such authorities as Prof. Ostwald, should turn out to be merely a mare's nest.

The Electrical Conductivity of Organic Substances.

For the last ten years A. Bartoli has been investigating the electrical conductivity of organic substances and publishing papers at intervals on his results. He now draws the following conclusions respecting the dependency of the conductivity of aliphatic salts on temperature. At ordinary temperatures, or at the boiling points, the electrical conductivity of aliphatic alkylic salts of small molecular weight is greater than those of their higher homologues. The conductivity of such salts increases with the temperature, the coefficient of increase of conductivity being greater for salts of high molecular weight than for their lower homologues; the temperature coefficient of the conductivity, therefore, increases as the viscosity of the salt increases. In the one or two cases in which the conductivity decreases with rise of temperature, the anomalous behaviour is explained by assuming the presence of a trace of an aliphatic alcohol. By adding such an alcohol the conductivity of a salt may be caused experimentally to decrease with rise of temperature. The electrical conductivity of a salt still increases as the temperature is raised on adding to it aniline paraldehyde, a phenol, a ketone, or an acid.

Recent Researches on Gas Batteries.

FOR some time past serious efforts have been made in order to evolve a process by means of which it shall be possible to convert the stored-up energy of coal directly into mechanical energy without the assistance of the round-about methods of steam and machinery. There was a rumour recently that Mr. Mond, the well known chemist, had obtained favourable results in this direction by means of a gas-battery, and our readers are familiar with the encouraging results of Dr. Borchers, of Duisberg, who has succeeded in producing electric current by means of the combustion of carbon monoxide in a cell of peculiar formation. Although the effects obtained were necessarily on a small scale, the relation of the actual electrical energy to the energy which should be available according to theory was from 15 to 27 per cent., whereas there is no machinery at present working commercially that will give an efficiency of 10 per cent. Such experiments necessarily cause our attention to be attracted to every new research on gas batteries, for which it is predicted there is a great future. As regards this we are not disposed to be prophetic, although we are aware that many notable men of science indulge the dream that we shall soon be obtaining all our electric current directly from the energy existing latent in raw materials. Gas batteries may, however, have to be reckoned with; and it is a part of our function to place such researches as may relate to them before the notice of our readers. The most recently published results on gas batteries are to be found in the *Zeitschrift für Physikalische Chemie*, xiv., p. 577, in a paper signed by F. J. Smale. For previous researches, the columns of our own back numbers may be consulted. Smale has engaged in a determination of the electromotive force in the case of a large number of gas batteries of that type in which the electrodes are usually platinum strips coated with platinum black, and immersed partly in the gas and partly in the electrolyte. Experiments were performed in order to test the dependence of the E.M.F. on the nature and size of the plates as well as on the nature and concentration of the solutions. The results proved that the nature of the plates was without influence, for similar results were obtained with gold, platinum, and palladium, whilst variation in the size of the plate was explained very easily. The electromotive force appeared to be independent of the electrolyte and its concentration in the case of sulphuric, phosphoric, and chloracetic acids; and also, though less certainly, when potassium and sodium hydroxides, sodium sulphate and potassium chloride were used. Abnormal values, however, were obtained with the halogen acids and many salts, which Smale accounts for by the convenient hypothesis of the existence of secondary reactions. Gaseous "chains" of hydrogen-chlorine, hydrogen-bromine, and hydrogen-iodine were subjected to investigation, and the effect of the dilution of a gas was studied by comparison of a hydrogen-oxygen with a hydrogen-air chain, the E.M.F. in the latter case being about 10 per cent. lower. The mean of the results for these chains are:—

Hydrogen-oxygen	1·044 volts.
Hydrogen-chlorine	1·532 „
Hydrogen-bromine	1·111 „
Hydrogen-iodine	0·530 „

By immersing the electrodes in the same electrolyte at different concentrations, the electromotive force between the two solutions was found; and Smale publishes in his paper a number of tables recording these results. The E.M.F. in the oxygen-hydrogen chain falls regularly as the temperature increases; thus: 0° = 1·090 volts, 20° = 1·065, 40° = 1·033, 60° = 1·001, and from these numbers the temperature coefficient of the solution tension is calculable, giving the result $\frac{d\pi}{dt} = -0{\cdot}00140$; that is, the solution tension is inversely proportional to the absolute temperature. [With this paper may be usefully studied other recent papers by B. Neumann, "The Potential of Hydrogen and some Metals," (*Zeit. Physik. Chem.*, xiv., p. 193); and by H. M. Goodwin, "The Voltaic Chain," (*Ibid.*, xiii., p. 577), both of which have been noticed briefly in THE ELECTRICAL REVIEW.]

Researches Relating to Electro-magnetic Oscillations.

THE question of employing impulsion cells, metallic films, and bodies of similar behaviour, for detecting the nodes, &c., of electro magnetic vibrations, has frequently been raised, and we are glad to see it engaging the attention of the Physical Society. Some time ago, Mr. Rollo Appleyard read at one of the meetings, a paper describing the electrical properties of rods composed of metallic filings and gutta-percha, which we duly noticed. This has suggested to Prof. Minchin an enquiry into the behaviour of certain bodies in the presence of electro-magnetic oscillations, the results of which appeared in a recent issue of the Physical Society. Prof. Minchin has made a few observations on films and metallic surfaces formed by embedding fine metallic powders in thin layers of gelatine, shellac, and sealing-wax, spread out upon plates of glass. Taking the case of sealing-wax, we find that although the prepared surface presents the appearance of a continuous metallic surface, yet when it is placed in circuit with a battery and galvanometer, it behaves as a non-conductor, so much so that if the electrodes connected with the surface are also connected with an electrometer, it is found that the surface has an infinite resistance. Now if feeble electro-magnetic oscillations are produced in the neighbourhood of the non-conducting surface, it will refuse to respond and remain a non-conductor. Let the field around it be greatly increased, however, or let one of the electrodes be actually touched by a charged body, and then the surface becomes a conductor. Let its conductivity now be destroyed, and it will be found after this to respond very easily to the actions which previously produced no effect upon it. In other words, once we have succeeded in driving a current through the metallic powder surface, it responds to very feeble electro-magnetic impulses, whereas it previously failed to respond to strong impulses. It appears that the behaviour of the surface depends upon certain conditions, *e.g.*, in the case of gelatine, if this substance retains any plasticity, breaking of the contact is fatal to its conductivity, or if the substratum be hard, as in the case of sealing-wax, and if strong electro-magnetic impulses have been communicated to it, the surface may remain a conductor for a long time, whilst if they have been small, it rapidly reverts to its non-conducting state. In his experiments, Prof. Minchin has observed the following constant relation:—If the surface is in the non-conducting state, and a feeble electro-magnetic field is produced around it, it becomes a conductor; but if, while it is conducting, a strong field is produced around it, its conductivity is destroyed. He thinks it possible that a law of this kind holds for all such bodies. The nature of the change produced in them depends either on the amplitude or on the frequencies of the incident impulses; but, in order to verify the relation, we should be able to deal with a film which from a definite state of non-conductiveness, changes always to a definite state of conductivity; and this, so far, has been impossible. So far this interesting subject has not been investigated very thoroughly, although in addition to these experiments and those of Mr. Appleyard, to which we have alluded, we have read of several described in papers recently communicated by Mons. Branly to the Academy of Sciences at Paris. The subject is particularly inviting, and, indeed, promising, since the establishment of laws having an important bearing may result from deeper investigation; and it is to be hoped that Prof. Minchin and others who have approached it will be able to see their way to carrying the matter through.

THE CHRISTMAS LECTURES AT THE ROYAL INSTITUTION.

The sixth and concluding lecture of the series on "The Work of an Electric Current" was delivered by Dr. J. A. Fleming, on Tuesday, the 8th inst., in the theatre of the Royal Institution. This course of lectures has proved extremely popular, the theatre being filled on each occasion. Dr. Fleming showed many of the classical experiments of Faraday, and the store rooms of the Royal Institution were drawn upon for the actual apparatus with which the classical investigations recorded in the "Experimental Researches" of this scientist were conducted. Naturally the lectures were delivered in extremely popular language, but the subject was benefited rather than otherwise on this account, and in Dr. Fleming's hands the facts upon which electrical engineering is based received elaborately careful attention. Many of the experiments owed their success more to the manner in which they were shown rather than to any novelty in kind. Thus the lantern was used to show the magnetic effect of the loadstone and the cessation of magnetic force in an electro-magnet when the current is cut off. The electric bell was also explained by the aid of a gigantic shadow of a small model bell placed in the lantern, and the applause which greeted demonstrations of this kind showed the appreciation of the audience for something which was striking to the eye as well as being clearly explained, so that even the most unscientific visitor present could not fail to carry away some information. The generation of an electric current, which formed the subject for the first and a portion of the second lecture, was notable owing to the tests made with an electric eel, and the exhibition of the principle of Prof. Minchin's photo-electric cell. The stock experiments were all good of their kind, but necessarily are old friends with our readers. In the lectures dealing with the chemical heating and lighting effects of a current, the leading novelties to the technical visitor consisted in the care with which effects were measured. True, Dr. Fleming studiously avoided reading deflections, merely speaking of one current being greater or less than another, but the spot from the mirror galvanometer was thrown on to a gigantic scale, so that the magnitude of the effects were easily read by anyone who felt inclined to do so. The original experiment of Peltier with the antimony-bismuth cross was very effective, as the deflections were reproduced by the use of ice to show that the current actually did exercise a cooling effect at the junction, and when reversed, that heat was produced, this being proved by the lecturer's finger being placed at the intersection of the cross when the spot moved in the direction indicated by "hot" on the scale. In the lectures relating to heating and signalling, Mr. Dowsing and Mr. Preece had lent, respectively, a large number of heaters and cookers, and examples of the Post Office forms of telegraph instruments. Gray's telautograph was also shown in operation, and its action was explained by the aid of a model which closely resembled the mechanical analogue of tri-phase currents, which was exhibited in the same room last year by Prof. Silvanus Thompson.

Dr. Fleming's lantern galvanometers are the envy of many lecturers. One consisted of a Deprez-D'Arsonval galvanometer of the Holden type, arranged so that a projection of the scale and pointer could be thrown on the screen. Another was a modification of a hot wire cell tester, which could be slipped into the lantern like an ordinary slide, and had a scale from ·5 to 5 ampères. This was used to show the increase of current taken by a motor when caused to do work. As the course was by custom supposed to be "adapted to a juvenile auditory," Dr. Fleming was kind enough to use as simple apparatus as possible, and at various times gave instructions how elementary forms of current reversers, batteries, and galvanometers could be constructed by his younger hearers during their leisure hours at home. On the other hand, Mr. Wimshurst's large inductional machine and other heavy and elaborate pieces of apparatus were used to produce startling effects—startling to many who were present, owing to the magnitude of the results produced. We are quite sure that this course of lectures would benefit first year students of electrical engineering far more than the customary rigmarole they are expected to listen to.

THE TESTING AND INSPECTION OF ELECTRIC LIGHT CABLES.

[communicated.]

(*Concluded from page* 36.)

II.

To get a finished cable having a conductivity of 100 per cent. that of pure copper is a difficult, if not an impossible, task, and apart from this it is impossible to measure the specific conductivity of a finished cable without assuming one of two points, namely, first its weight, which can only be assumed, because it is impossible, or, at least, unadvisable, to strip the cable to ascertain this; and secondly, that its diameter does not vary throughout its whole length, but is the same throughout as at the ends bared for testing purposes. This it will be seen makes a guarantee of 100 per cent. from the maker worthless, as he can only base it upon calculations into which he has had to introduce one of two suppositions, as explained before. The next best thing is to specify that the finished cable shall have a *resistance* equivalent to one of 100 per cent., which can be obtained by calculation, thus leaving the maker a slight margin in diameter for alteration due to the various processes of manufacture, or for irregularity in the diameter of the strands themselves; the separate wires themselves before stranding can, of course, be tested for conductivity with absolute accuracy, as they can be weighed, thus eliminating any slight error of diameter, and it may be insisted that any wire so measured should have a conductivity of 100 per cent., but for the reasons given above this clause cannot be insisted on with regard to the finished cable.

Where mercury contacts are used in resistance measurements, care must be taken to get a *wet* metallic contact, that is to say, the end of the rod or wire must be thoroughly amalgamated with mercury. This may be obtained by rubbing the end of the wire with nitrate of mercury, or if this is not at hand, it may be dipped successively into acid and mercury, which will answer the same purpose.

For measuring the specific conductivity of copper, Messrs. Elliott Bros. make a very convenient little instrument which does not seem to be as well known as it deserves. By its use the temperature of the wire under test becomes negligible, provided only that both sample and instrument are at the same temperature, also no ohmic measurements by Wheatstone bridge or other method is necessary; in taking the test the sample is inserted as an "x" in a Wheatstone mesh, and the length is adjusted until balance is obtained. The arm of the instrument which corresponds with the variable resistance (d) in a Wheatstone bridge is composed of one or more coils having different length-weights, such as 200 inches, 100 grains, &c., the one nearest the sample value being inserted by means of a plug.

In event of this instrument, or some similar device, not being at hand, the measuring of the ohmic resistance of the sample becomes necessary, which is, of course, quite as accurate, though perhaps a more tedious operation. The electrostatic capacity of electric light cables is generally assumed to be a matter not worth consideration, and in a large number of cases this is so, and the limit is seldom or never fixed; for direct current working this is quite permissible, but with alternating current the question is one which, in the writer's opinion, hardly receives the attention it deserves.*

It is unnecessary to give here details of the methods used for ascertaining the actual capacity of a cable, as they are well known to those interested in the matter, and are to be found in all text-books on the subject. It may, however, be well to point out that when only one or two cells are used in determining this quantity, a serious error may possibly arise from the fact that the earth plate or wire may have an E.M.F. of its own acting with or against the charging cells, and as in taking the constant or standard deflection from the condenser an earth is not generally used, the capacity of the cable under test will appear more or less, according to circumstances.

* The late Robert Sabine, C.E., devoted some attention to this point years ago.—Eds. Elec. Rev.

ON THE THERMO-ELECTRIC PROPERTIES OF PLATINOID AND MANGANIN.*

BY B. O. PEIRCE.

DURING the last few years the attention of many physicists has been occupied with the attempt to discover an alloy in every respect suitable for making standards of electrical resistance. Such an alloy, it is evident, must be non-magnetic, ductile, not easily corroded and easily soldered to copper and brass. It must have a high specific resistance independent of the temperature, and, when drawn into wire, its resistance must not be subject to secular change.

No one substance† is yet known to satisfy all these conditions completely, and, since there is still some doubt about the permanency of artificially seasoned resistance coils made of manganin wire, many makers of standards prefer to use platinoid in spite of its comparatively high temperature coefficient.

I have been trying of late to reduce as much as possible the disturbing effects of thermo-electric currents in a certain standard slide wire bridge and have had occasion to determine the thermo-electric relations of copper to such platinoid‡ and manganin§ as are to be obtained in the market. A few years ago such determinations would have had very little practical value, since different specimens of copper had very different positions in the thermo-electric scale, but this last statement is no longer true of copper bought in the American market. I have tested against each other many specimens of copper wire of different sizes, chosen at random from a rather large stock bought at intervals during the last five years, and the highest electromotive force that I have obtained was 0·06 microvolts per Centigrade degree, and this was very exceptionally large. I believe that a thermal junction made of two specimens of annealed copper wire bought of different reputable makers would probably not yield more than one or two C.G.S. units of electromotive force per Centigrade degree even if one were as large as No. 10 and the other as small as No. 36 on the American gauge.‖ Prof. E. H. Hall tells me that he has tested several specimens of commercial copper wire of different sizes against plates of electrically deposited copper, and that the electromotive force of every one of these combinations was extremely small or insensible. When such results as these are compared with those obtained 15 or 20 years ago,¶ it is evident that great progress has been made in the manufacture of copper wire for electrical uses and that commercial copper has now a pretty definite thermo-electric position.

The platinoid wire which I used was of two sizes (Nos. 19 and 28 of the American gauge) and was bought about four years ago of Messrs. Elliott Brothers, of London.

The so-called "manganin" wire was of seven sizes bought at different times through Messrs. Gillis & Gleeson, of Messrs. Bradford, Kyle & Co., of Plymouth, Mass. The largest size (No. 18) was hard drawn, the other sizes were all annealed. Three specimens (Nos. 18, 26 and 30) showed when examined qualitatively only a trace of nickel in combination with copper and manganese.

Each of the wire thermal junctions when in use was immersed close to the bulb of a thermometer in a bath containing about a litre and a half of heavy paraffine oil and furnished with a stirring apparatus. Each oil bath was set into and jacketed by a vessel of about 10 litres capacity into which ice or warm water or steam could be introduced, or which could be used as an air bath. The electromotive forces of the different combinations were determined by compensation on a potentiometer. When, for the purpose of obtaining a rough check on the other results, quicksilver was opposed to platinoid or to manganin, the lower end of a very large test tube containing about 40 grams of redistilled mercury was deeply immersed in each oil bath and the contents of the two tubes were connected by a long glass siphon filled with mercury. The bulb of a thermometer and an end of a piece of wire of the kind to be examined were immersed in the mercury of each test tube and obvious precautions were taken to prevent undue loss of heat from the contents of the tubes. The following table gives the results of observations made in this way with platinoid wire, No. 19, and with hard drawn manganin wire, No. 18. In each case the current passes across the hot junction from the first-named metal to the second, the electromotive forces are measured in microvolts and the temperatures of the junctions are given in Centigrade degrees.

TABLE I.

Temperatures of the junctions.	Electromotive forces.	
	Mercury *v.* Manganin.	Platinoid *v.* Mercury.
0° and 10°	66	123
0° „ 20°	136	246
0° „ 30°	209	372
0° „ 40°	283	500
0° „ 50°	359	631
0° „ 60°	438	766
0° „ 70°	524	906
0° „ 80°	613	1,048
0° „ 90°	704	1,190
0° „ 100°	797	1,331

When the hard drawn manganin wire, No. 18, in a thermal junction was for the first time raised to the temperature of boiling water and then slowly cooled, the results of a series of observations of electromotive force taken during the cooling were sometimes rather irregular though they agreed in general fairly well with the regular results (in complete agreement with one another) obtained on a second, third, or subsequent heating. The platinoid wire always gave regular results from the first, and these were repeated with a given specimen as often as the junctions were brought to the same temperatures. The annealed manganin wire showed no irregularities on first being heated. The results of a large number of completely accordant observations with thermo elements made of copper and either platinoid wire, No. 19, or manganin wire, No. 18, are given in the next table.

TABLE II.

Temperatures of the junctions.	Electromotive forces.	
	Copper *v.* Manganin.	Platinoid *v.* Copper.
0° and 10°	4·3	189
0° „ 20°	9·2	379
0° „ 30°	14·1	572
0° „ 40°	19·6	769
0° „ 50°	25·7	971
0° „ 60°	32·6	1,179
0° „ 70°	40·2	1,391
0° „ 80°	48·1	1,609
0° „ 90°	56·4	1,834
0° „ 100°	64·9	2,063

The thermo-electric effects at the junctions with their copper terminals of resistance coils would evidently be far less under given conditions if the coils were made of this specimen of manganin than if they were made of the platinoid. Moreover this hard drawn manganin wire could advantageously be used as a slide wire, since accidental heating of a portion of the wire would not alter its resistance appreciably and since the thermo-electric effects at the junctions of the slider would be insensible. On account of its high specific resistance very fine manganin wire has been much* used as slide wire in potentiometer work.

A pair of thermo-electric junctions made of copper wire

* From the *American Journal of Science*, Vol. xlviii., October, 1894.

† Feussner and Lindeck:—*Zeitschrift für Instrumentenkunde*, 1889, pp. 233—236. Nichols:—This Journal, 1890, pp. 471—477. Ahler, Haas and Angerstein:—*Electrotechnische Zeitschrift*, 1891, p. 250. Feussner:—*Electrotechnische Zeitschrift*, 1892, p. 66. Milthaler:—*Wiedemann's Annalen*, xliv, 1892, pp. 297—305. Lindeck:—*Wiedemann's Annalen*, xlvi, 1892, pp. 515—516. Weichert:—*Wiedemann's Annalen*, lii., 1893, pp. 67—75.

‡ Bottomley and Tanakadaté:—*Phil. Mag.*, xxviii, 1889, pp. 163—169.

§ Englisch:—*Wiedemann's Annalen*, l., 1893, pp. 88—110.

‖ The diameter in inches of wire No. n in the American gauge is approximately $(0{\cdot}32)\ 2^{\frac{n}{6}}$.

¶ See Everett's Physical Constants, p. 151

* H. M. Goodwin:—*Zeitschrift f. Physikalische Chemie*, xiii., 4, 1894.

and a piece of the manganin wire, No. 18, which had been kept for about a minute at red heat and then suddenly cooled, gave an electromotive force of 65·9 microvolts when one junction was kept at 28° and the other at 93°. It is instructive to compare this result with the results of experiments mentioned below which were made with manganin wire thoroughly annealed in the manufacture.

The numbers given in Table II. for the electromotive force of platinoid against copper do not agree very well with the results obtained by Messrs. Bottomley and Tanakadaté, who found for the electromotive force of this combination the two expressions, $-1{,}246 - 5{\cdot}44\,t$, and $-1{,}294 - 4{\cdot}88\,t$, in C.G.S. units. My experience seems to show, that as these gentlemen suspected, different specimens of platinoid wire have different places in the thermo-electric scale. A number of thermopiles, made of platinoid wire, No. 28, and copper, gave results which agreed with one another perfectly, except for such extremely slight differences as might properly be charged to errors of observation, but these results were quite different from those obtained with the larger platinoid wire and much closer to those of Messrs. Bottomley and Tanakadaté.

Table III.

Temperatures of the junctions.	The electromotive force of platinoid wire, No. 28 *v.* copper.
0° and 10°	152
0° and 20°	306
0° and 30°	465
0° and 40°	628
0° and 50°	799
0° and 60°	973
0° and 70°	1,159
0° and 80°	1,356
0° and 90°	1,569
0° and 100°	1,787

Of annealed manganin wire I had considerable quantities of nine different specimens, and these were of six different sizes, 22, 26, 28, 30, 33, and 36. Of this wire, Mr. C. J. Shanahan and I made a very large number of thermo-electric junctions, sometimes opposing one specimen of manganin wire to another and sometimes to copper. Experiments with these junctions showed that one specimen (No. 22) differed rather widely from the others, which were thermo-electrically pretty close together, and that the thermo-electric position of the abnormal wire was in no way changed by heating it repeatedly red hot and cooling it suddenly.

Table IV. gives the results of numerous experiments upon thermo-electric junctions made of annealed manganin and copper. The numbers in the first column of electromotive forces were obtained with the No. 22 wire just mentioned; the numbers in the last column are the averages of corresponding numbers in a table where each of the other eight specimens of wire had a column for itself. There were slight persistent differences between these last mentioned wires, but there was no apparent relation between the size of a wire and its thermo-electric position. It will be noticed that the electromotive force of no one of the manganin-copper combinations experimented on was greater than about one-seventh that of the weakest of the platinoid-copper combinations under similar circumstances.

Table IV.

Temperatures of the junctions.	Electromotive forces of	
	Copper *v.* manganin wire, No. 22.	Copper *v.* ordinary annealed manganin.
0° and 10°	24·0	17·3
0° and 20°	48·0	34·7
0° and 30°	72·5	52·3
0° and 40°	97·4	70·1
0° and 50°	123·0	88·0
0° and 60°	149·0	106·0
0° and 70°	175·0	124·4
0° and 80°	202·0	143·0
0° and 90°	229·0	161·4
0° and 100°	257·0	180·0

Jefferson Physical Laboratory, Cambridge, U.S.A.,
August, 1894.

THE INCANDESCENCE LAMP.*

By A. BAINVILLE.

(*Continued from page* 583, Vol. 35.)

We have seen that when the vacuum is as perfect as can be obtained by means of the pumps, the lamps are lighted and left for a considerable period, at the end of which they are detached from the pumps. This essential operation entails considerable expenditure, and absorbs nearly the whole of the power available at the works.

The choice of the most suitable electric installation is a very delicate matter, owing to the flexibility required from such an installation. The lamp makers must, in fact, be in a position to construct lamps of any voltage whatever, seeing that the installations now in existence are far from being uniform in this respect. The problem before us is consequently this: to produce with a good industrial efficiency, and as little plant as possible, an almost constant quantity of electrical energy with a variable voltage.

According to the mode in which the lamps are lighted, the solution of the problem differs considerably. If the work is alternative, *i.e.*, if the lamps are lighted in groups, the total energy required for a day's work, for instance, must be supplied under a greater power than if the work is continuous. It follows that in the first case much more plant is required than in the second if it is desired to employ the current directly. It would, therefore, be to one's interest, in the case of alternative work, to have recourse to accumulators. This solution of the problem, which seems to fulfil all the requirements of the manufacture, and at the same time to entail a better utilisation of the plant, is, however, seldom resorted to, probably on account of the inconveniences attending the employment of accumulators, especially when their grouping has constantly to be altered.

For the continuous lighting of an almost constant quantity of lamps the electrical energy supplied per unit of time will be, to all intents, constant if the quality of their manufacture is normal. We must, therefore, produce, in this case, a quantity of energy equal to that in the preceding case, but of constant power and variable voltage. The most logical solution would be to employ an alternating current with transformers; but when we consider the number of low power transformers that would be necessary, we find that such an installation would be very expensive, and its efficiency is not sufficiently satisfactory to justify this excessive outlay. These various considerations have led most lamp makers to use simply continuous current dynamos. In order that the working of these machines may be rendered more elastic, they can either be excited separately or constructed specially for the purpose. Dynamos can easily be obtained whose voltage is capable of varying within very wide limits while the efficiency remains, to all intents, constant. The only inconvenience of this method is that it necessitates the employment of machines of higher power than is required, seeing that when their difference of potential is lowered, the energy furnished in the unit of time necessarily diminishes in proportion; consequently the machine must be capable of producing the maximum power required with the minimum voltage. Certainly we can group the lamps in series, and thus considerably reduce the sudden changes of voltage.

In order to complete the regulation of the lighting of the lamps on the pumps, rheostats must be brought into requisition. The most correct mode of procedure would be to provide each lamp with a special rheostat. Certain factories have been fitted up in this manner; but, besides the fact that an installation of this kind costs a great deal to establish, it is useless when the manufacture is well conducted. In fact we should only mount on the pumps lamps constructed to work at a given voltage; these lamps differ from one another so very slightly that they can be lighted at the same voltage without any inconvenience. One rheostat to each pump is then sufficient and in certain cases we can even content ourselves with a single rheostat for a group of pumps.

The lamps are connected with the line by means of flexible wires and a commutator enables the current to be cut off in the lamp or series of lamps mounted on the same pump.

When the current has been sent into the lamps long

* *L'Electricien.*

enough, a workman detaches them by means of a special blow-pipe. We have then to ascertain whether the vacuum in the lamps is sufficiently complete. We know, in fact, that on the quality of the vacuum depends the quality of the lamp, and a good maker does not send out lamps in which the vacuum is inferior. This testing of the vacuum is unfortunately very difficult and we have at our disposal only rough and imperfect methods for practically testing this quality, which is at the same time a most essential one. The only apparatus that is capable of measuring the vacuum is the MacLeod gauge. The principle of this apparatus lies in reducing the volume of a mass of rarefied gas until its pressure is rendered measurable.

Fig. 12 shows MacLeod's manometric gauge; A B C is the receiver in which the gas is compressed, it is formed of two reservoirs, B C and C D, surmounted by a tube of small diameter, A B. The tube, E F, which is in communication

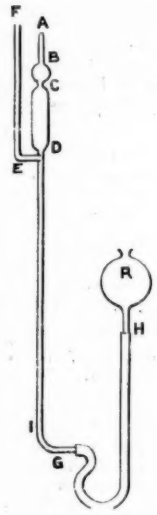


Fig. 12.

with the vessel to be emptied, is fused at D to the base of the reservoir, D; the tube, D I, is rather longer than the barometric column and is connected at the bottom to the reservoir, R, by means of an India-rubber tube, G H. The tube, A B, is graduated in millimetres, or what is still better the capacities corresponding to the divisions of this tube are gauged in succession and also the total volume, A D; we thus get the ratio of the successive capacities of the tube, A B, to the total volume, A D. As to the tube, E F, it is graduated from the bottom to the top starting from the lowest division of A B. The whole apparatus is fixed on a vertical board.

When the apparatus is to be used it is put in communication with the pump by means of the tube, E F, after a sufficient quantity of mercury has been poured out at R to fill A G, and the reservoir, R, is left at the bottom of its course, *i.e.*, on a level with the bottom of the tube, D I. When the work of the vacuum pump is finished, the mercury rises in D I to a little below the point, D. The reservoir, R, is then raised very slowly, consequently the mercury rises and soon reaches the point, D. At this moment a known volume of gas, V, has been enclosed in the receiver, A D, at a pressure, x, which must be determined. By continuing to raise R, this gas is compressed; the rising of the mercury is stopped at the moment that an appreciable difference of level is observed between the column in E F and in the tube, A B.

In order to avoid capillary corrections, the tubes, A B and E F, are chosen with the same diameter. Let V be the volume measured by the tube, A B, under which the gas has been reduced, and L the difference between the levels of the mercury in E F and A B; the pressure to which the compressed gas is subjected is now $x + L$; we can therefore write in accordance with Mariotte's law,

$$V x = V' (x + L), \text{ whence } X = \frac{L}{\frac{V}{V'} - 1}.$$

We know the ratio, $\frac{V}{V'}$, from the preliminary gaugings, we measure L directly, we can therefore ascertain the pressure, x, of our rarefied atmosphere.

In order to avoid the errors that might result from the application of Mariotte's law, MacLeod advises that the ratios, $\frac{V'}{V}$, should be determined by measuring the tensions of a known gaseous mass compressed in volumes corresponding to the various values of V'.

The manipulation of this apparatus is very delicate, and the indications given by it may be altogether falsified if certain precautions are neglected; we can therefore understand that it can only be employed in the lamp industry in order to establish types for comparison, and its employment can never become general. Moreover, if it did, each vacuum pump would have to be provided with a gauge, which would considerably complicate the installation and render it very expensive. To test the completeness of the vacua therefore, the maker must have recourse to a more expeditious and less expensive method. That usually employed is far from giving exact or even comparable results, and its employment moreover requires considerable practice. It is based on the luminous phenomena produced by the discharge through rarefied gases. It is, in fact, a method of observation, and not a method of measurement; everything depends on the skill of the operator and the care which is taken to make the conditions always identical.

It is well known that a discharge passing through a rarefied gas, produces in this gas a luminous effect which becomes less and less intense as the rarefaction in the vacuum tube is carried further and further, and that this effect is more brilliant for the same degree of rarefaction in proportion as the difference of potential between the two electrodes is higher; the phenomenon is at its maximum in the immediate neighbourhood of the positive electrode, whereas round the negative electrode it is imperceptible.

If then we obtain suitable conditions and keep the difference of potential constant, we can deduce from the aspect of the lamp that is being subjected to the discharge indications as to the condition of the vacuum in this lamp. It must be observed that the phenomenon varies according to the nature of the glass of the bulb; crystal gives a blue phosphorescence, whereas Bohemian glass gives a green colouring.

The lamp maker must then test the vacuum he has obtained by means of an induction coil suitably regulated. For this purpose all the lamps are passed, after being detached from the pumps, between the poles of the coil. Those whose bulbs are completely filled with a kind of luminous cloud or even in which the phosphorescence spreads almost over the entire surface of the glass, must be rejected as their vacuum is not sufficiently complete to render good service.

The Standardising of the Lamps.

Now that the manufacture of the lamp is quite finished we must ascertain whether it fulfils the conditions laid down at the time of its construction; for instance, it must be ascertained whether a lamp constructed for 16 candles at 100 volts really gives 16 candles when a difference of potential of 100 volts is established at its terminals, and the consumption of electrical energy must also be tested. This work is what is called the standardising or photometric measurement of the lamps.

At the commencement of the lamp industry, this operation was not only a test but a sorting; the classing of the lamps was regulated by the photometric measurement. Now this is merely a check and shows no little progress when we consider the difficulties and uncertainties that are involved in the work of the photometer. Photometric measurement is, in fact, unfortunately, an extremely delicate operation; the eye of the observer is really the measuring instrument. On the sensitiveness of this very unstable instrument, therefore, depends the accuracy of the measurement, and this sensitiveness only increases with practice. A person who only makes photometric observations from time to time is generally absolutely incapable, without several days' practice. A somewhat brilliant light is sufficient to deprive one of all the benefit gained by long training. Lastly, the personal co-efficient is of considerable importance in observations of this kind: the same measurement made by different observers may furnish results differing from one another as much as 20 per cent. and sometimes more. If all the lamps in one series are to all intents identical, their standardising

is effected much more quickly, and owing to the slightness of the difference in the lighting of the photometer screen in the various successive measurements, the eye of the operator is placed under better conditions as to sensitiveness. Various methods are used for determining the luminous power of incandescence lamps, but in almost all works the Bunsen grease spot photometer is used. The spectro-photometers and various other photometers which may give more accurate results in laboratories are too delicate of manipulation to be employed for industrial purposes. With a well-trained observer, the measurements taken with the Bunsen photometer can be effected very quickly, and at the same time the results obtained are comparatively very accurate.

(*To be continued.*)

RESULTS OF THE ELIHU THOMSON COMPETITION.

The Elihu Thomson electrical energy meter, having obtained at the meter competition, organised by the City of Paris, a first prize of 5,000 francs, Prof. Elihu Thomson generously devoted this sum to facilitating the study of certain theoretical questions of great interest.

This competition is now ended, but before stating the conclusions of the jury, we will give a brief sketch of the history of the competition. Towards the end of the year 1889, the City of Paris organised a competition of electrical meters, and placed at the disposal of the jury a sum of 20,000 francs to be given in prizes. But the result of the little time allowed the competitors in which to submit their instruments was that very few meters were sent in and none of them entirely satisfied the conditions of the programme.

Nevertheless, at the request of the jury, a sum of 7,000 francs was distributed in prizes of encouragement, and a second competition was organised.

The conditions of this second competition were as follows:—

Article 1.—A competition is open to all inventors of electrical meters that can be applied, either to continuous currents alone, to alternating currents alone, or to both forms simultaneously.

Article 2.—The meters submitted may be either electricity meters (ampère-hour-meters) or energy meters (watt-hour-metres).

Article 3.—The readings of the meter must be direct, and the consumer must be in a position to ascertain for himself the quantities consumed.

Article 4.—The meters must be suited to small consumptions; the electricity meters must register from $\frac{2}{10}$ths of an ampère, and the energy meters from 20 watts.

Article 5.—The meters, together with an explanatory note, must be deposited in a sealed package, at the Halles Municipal station, from the 25th to the 31st of August, 1890, without fail. A receipt will be given for them.

Article 6.—The meters will be submitted to a committee consisting of nine members, five of whom will be appointed by the Municipal Council, and four by the Administration.

Article 7.—The instruments will be subjected to comparative experiments bearing upon:

(*a*) Their accuracy throughout the scale of outputs that they are capable of recording.

(*b*) Their practical value (regularity, simplicity, cost, &c.)

(*c*) The energy expended in their working.

(*d*) The amount of trouble entailed by their employment in the distribution of current.

Article 8.—A sum of 13,000 francs will be distributed in prizes under the following conditions:—

10,000 francs to the inventor who will produce a meter giving every satisfaction, and applicable either to continuous or alternating currents.

If the meter is only applicable to one of these forms the inventor would only be entitled to half the prize.

Prizes amounting to 2,000 francs for meters intended for both alternating and continuous currents, and to 1000 francs for meters applicable to only one of the two forms of current, will be awarded to those inventors whose apparatus shall have realised any important improvement.

The Elihu Thomson meter which was not ready for the first competition, owing to the little time allowed, obtained a first prize of 5,000 francs, as entirely fulfilling the conditions laid down.

Prof. Elihu Thomson then wished that other scientists should profit by the generosity of the City of Paris, feeling that the distinction he had gained was sufficient for himself, and, he therefore, charged M. E. Thurnauer, the general European agent of the Thomson-Houston Company, to organise a competition, having for its object the advancement of science.

In September, 1892, the following programme was put before the scientific world through the medium of electro-technical journals.

The Elihu Thomson Competition.

Prof. Elihu Thomson obtained, at the last competition instituted by the City of Paris for the best electrical energy meter, a prize of 5,000 francs. Wishing this sum to be employed for the development of theoretical electrical science, he charged the undersigned who is the general European director of the Thomson-Houston system to form a committee for the organisation of a fresh competition, the object of which should be the study of theoretical questions, the prize offered being the sum of 5,000 francs. The committee was composed of the following persons, who readily accepted the position of member:—Messrs. J. Carpentier, president of the Société Internationale des Electriciens; Hippolyte Fontaine; E. Hospitalier, professor at the Ecole de Physique et de chimie industrielles of the City of Paris; E. Mascart, of the institute; A. Potier, of the institute, reporter to the competition committee; B. Abdank-Abakanowicz, consulting engineer, secretary to the competition committee.

The committee decided that the competition should bear upon the following subjects:—

1. The study of the heat generated by the successive charges and discharges of condensers, varying the magnitude of the charges, the frequency, and the nature of the dielectric.

2. Theory indicates that when the armatures of a condenser have been connected by a conductor, the condenser becomes the seat of alternating currents whilst its resistance falls below a certain limit. The formula which enables the period of these oscillations to be calculated has not up to the present been fully verified. The problem set is to find this period experimentally under conditions in which the exact measurement of the resistances, capacities, and co-efficients shall be possible, so as to arrive at an accurate and complete verification of this formula.

3. When a condenser formed of an imperfect insulating material has been charged and then left to itself, the charge of the armatures is progressively dissipated; the time required to reduce this charge to a certain fraction of its initial value depends only on the nature of the insulating material. It is asked whether, as certain recent theories assume, similar phenomena occur in metallic conductors, whether there are experimental reasons for thinking so, and what is the rate of time for conductors of this kind.

4. The establishment, by co-ordinating and generalising facts at present known, of graphic methods of solving electrical problems proceeding on the same lines as in graphic statics.

The papers presented may be written in any of the following languages: German, English, Spanish, French, Italian, or Latin. They may be either written or printed.

Each of the papers presented must be marked with a certain device, and accompanied by a sealed envelope bearing on the outside the same device as the paper, and on the inside the name and address of the candidate.

The papers must be sent in before September 15th. 1893, to M. B. Abdank-Abakanowicz, secretary, 7, Rue du Louvre, Paris, who will furnish any information required.

(Signed) E. Thurnauer.

Four papers were sent in in response to this appeal:—

1. "Die Bewegung der Erde ist die Quelle des Lebens."

2. "Vigentia." "On dielectric hysteresis."

3. "ηλεχτρον." "An examination on the absolute accuracy of the formula for calculating the period of free oscillation of a discharge condenser under circumstances such that the resistance of the circuit has no appreciable disturbing effect."

4. "Ουτις εμοι γ ονομα." "An experimental determination of the period of electric oscillations."

The members of the committee, after examining these papers, came to the following conclusions:

The first paper, "Die Bewegung der Erde ist die Quelle des Lebens," does not treat of the subjects specified in the programme.

No. 2 contains some very interesting facts, but does not throw any new light on the question of the hysteresis of dielectrics.

No. 3 is devoted to the verification of the formula giving the period of the oscillating discharges of a condenser. This is a very exhaustive paper accompanied by several photographs, and in it the writer has endeavoured, by means of profound calculations to estimate all the corrections entailed by his method.

The verification is only approximate; the principle of the method is open to some criticism, the circuit of the discharge being closed periodically by a spark which introduces disturbances impossible to foresee.

Paper No. 4 treats of the same subject, studied by a method new in its details, and which has enabled the writer to attain and to measure periods of some hundred-thousandths of a second. The influence of the principal causes of error appears to be very slight, although some doubts still remain as to the influence of the capacity belonging to the self-induction coil. The formula has been verified to within about 1 per cent. The writer had not time to complete his researches by varying the conditions of his experiments.

The report of the Committee is as follows:—

The Committee is of opinion that paper No. 4 has gained the prize offered by Prof. Elihu Thomson, and hopes that this tribute to his ability will encourage the writer to continue his splendid researches. At the same time the Committee regrets not having at its disposal two prizes of equal value to be awarded to papers 3 and 4.

The success of this competition is a matter for congratulation for, besides the two papers referred to, others of considerable merit have been sent in.

In compliance with the wishes of the committee and in consequence of the steps taken by M. Thurnauer, Prof. E. Thomson, of Lynn, the French company for working the Thomson-Houston methods, the Meter Manufacturing Company, the chief agents for the Thomson meter in Europe, and the British Thomson-Houston Company, Limited, of London, have contributed to offer a second prize of 5,000 francs.

The envelopes containing the names of the writers of the prize papers were opened, and the committee awarded one prize of 5,000 francs to Dr. A. Webster, of Clark University, Worcester, Mass., U.S.A. (paper No. 4), and another prize of 5,000 francs to Dr. Oliver Lodge, of University College, Liverpool, who collaborated with Mr. Glazebrook, of Trinity College, Cambridge (paper No. 3).

The Secretary of the Committee,

B. Abdank-Abakanowicz.

LIFTING NATURE'S VEIL.

Few things are more annoying to the technical man than to observe the freaks of the newspaper press in booming inventions or so-called discoveries in such language as lead the non-technical reader to believe that some great revolution is taking place in electrical science. When the opinions of qualified experts are consulted, it generally happens that the "ingenious young men" who are so highly praised, have not in the least degree exceeded the achievements of their predecessors.

These remarks apply to articles which have been published in the London and provincial papers within the past week (evidently from the pen of a popular penny-a-liner) regarding an "Important electrical discovery." This so-called discovery we dealt with last week in a few lines at the conclusion of our extracts from the report of Prof. Andrew Jamieson on the Walker-Wilkins battery.

The *Morning*, in addition to a startling paragraph published in Monday's edition, comes to the fore in Tuesday's issue with a leader on the subject. Our contemporary expects great and, perhaps, sudden discoveries in the field of electrical science, but, failing any "grandiose achievement," the editor considers

> We may well be content with such a useful and timely invention as that of the Walker-Wilkins battery, which we now learn has been favourably reported upon by so eminent an authority as Prof. Andrew Jamieson, of Glasgow. Electric lighting and electric power are boons denied at present to those who are not within easy distance of a dynamo, but the new non-polaring voltaic battery, which, besides being as portable as a portmanteau, yields a remarkably steady current with an extremely small consumption of zinc and other material, promises to change all that. To its uses, indeed, there would seem to be no end. It ought to light houses in the remotest country districts, railway and private carriages, signals, lighthouses, and mines, while as a motor up to, perhaps, 2 or 3 horse-power, it ought to find its way into places where neither the steam nor the gas engine is available.

And then the *Morning* tells the oft repeated tale of what electricity will some day do.

All the purposes for which the *Morning* suggests the Walker-Wilkins battery should be used have been suggested for every battery that has been rediscovered (!) during the last 10 to 15 years. It is, of course, not to be expected that the *Morning* or any other newspaper has even an elementary knowledge of electro-technics, but the least the editors could do would be to be a little temperate in their remarks, or, better still, consult an expert as to the capability of the invention.

The idea of a zinc-carbon primary battery being adapted to lighthouses, and acting as a motor of 3 H.P., is too funny, and to all whom it may concern, we call attention to the Electrical Review of January 4th last, page 16, where Prof. Jamieson declared it was physically impossible to obtain more than a well-known output in ampère-hours per pound of *zinc used in any primary battery*, and that to produce 1 horse-power-hour by zinc, sulphate of copper, and copper, would cost at least 30 times the sum for which it can be developed by the dynamo.

The same applies to the Walker-Wilkins element, for which, as we said last week, it is claimed that the *novelty* of the cell is that it depends upon the atmosphere as its depolarising agent. Even this must be denied it, for on page 111 of Prof. Carhart's "Primary Batteries," there is a description of a battery absorbing oxygen from the air. Again, Dr. Byrne (see Electrical Review for June 1st, 1878), pumped air into his battery, "by which the metallic surfaces are kept constantly clear, or *depolarised*."

Surely, too, the auto-accumulator of Paul Jablochkoff, which we so severely criticised in the year 1885, depended upon the atmosphere for its depolariser?

Caustic potash has been used over and over again, notably, by Scrivanoff, and the most that can be said for the "great electrical discovery" is that it is a well-arranged battery of its class, both electrically and mechanically. There it ends. Electricity may be to the *Morning* almost as great a mystery as ever, but to us, in these days of enlightenment (?), the *Morning*, and its contemporaries, are still greater mysteries.

Probably, some day, "Nature will finally allow the veil to be lifted which still shrouds one of her greatest secrets," but it seems hopeless ever to expect that the veil of technical ignorance will be lifted from the minds of newspaper representatives, notwithstanding the advantages now offered, even to editors, of attending elementary science classes.

PROF. THOMPSON ON THE ARC LAMP.

Prof. Silvanus Thompson delivered his second Cantor lecture on the "Arc Lamp" on Monday night at the Society of Arts.

Dealing more specifically with the optics of the arc lamp, the professor went on to show the amount of light emitted from the arc in various directions. He paid a well deserved tribute to the work carried out by Mr. Trotter on this subject. An apparatus used for getting the candle-power curves, designed by a student of Prof. Thompson, was next described. By means of this, the light given out in any direction could be examined with the greatest ease. Finally, the fact was clearly enunciated that the light in any direction was directly proportional to the crater surface, the relation between crater surfaces and current was dwelt upon, and the lecturer passed on to consider the white light of the arc as standard of light. Such a standard had been suggested by the lecturer and Mr. Swinburne simultaneously, but it had been found that there were such extraordinary variations, that it would be impossible to use it as a standard. Variations might be caused by impurities in the carbons, or if a soft core was put in the carbon for the purpose of steadying the arc, there would be a dull patch. When experimenting with the arc, Mr. Trotter had found that if you project an arc, and get it to a steady position, they would discover somewhere in the middle of the luminous crater, not always exactly in the centre of the light, a nebulous patch, sometimes extending in different directions, which was rather whiter than the rest, and sometimes you could see this patch going round and round. They could not, of course, see this unless they resorted to artificial means; they could detect it if they saw the arc through a revolving bit of cardboard. What they saw was a sort of comet, which turned round capriciously in the arc. Mr. Trotter had also found that the flame itself revolved at times in a capricious manner. All this would affect the whiteness of the arc, and would therefore constitute a distinct objection to using it as a standard. Speaking of the energy supplied to an arc lamp, he said that only 4 or 5 per cent. was effective in giving illumination; that is, for every ray of light given out from the arc lamp, there were 24 invisible heat rays. In conclusion, the lecturer referred to the discussion which had taken place on the different efficiency of alternating and continuous current arc lamps; he did not wish to question the results which had been obtained, but it did seem to him perfectly absurd, if they used the right kind of mechanism and used the proper amount of current, to suppose there would be any difference in efficiency in alternating or continuous current lamps where there is room for no difference; some idea once prevailed that incandescent lamps worked in this way were different in efficiency.

CORRESPONDENCE.

Muirhead v. Commercial Cable Company.

Since the late decision of the Court of Appeal with regard to the above case, the duplex patents of Messrs. Muirhead and Taylor of 1876 and 1880 have been commented on by several technical journals. Some of the writers have been favourable to the upholding of the 1880 patent, others, amongst them yourselves, have taken a different view.

My own opinion is that the writer of the article in *Engineering* has ably handled the subject, and presented the facts in a clear and intelligible way to his readers.

In this communication I do not propose discussing the points which have been before the Courts, but confine my remarks to replying as shortly as possible to the leaderette in the Electrical Review, and to add something in reference to the views expressed to you by an "excellent authority."

I should like to state that since 1878 I have from time to time been engaged upon the application of the duplex system to cables, and during that time have "duplexed" many thousands of miles of line, consequently the advantages of the combination claimed in the 1880 patent, and the method

of working under the 1876 patent, are equally familiar to me. The "desirable result" obtained by the application of the combination claimed in the 1880 patent has until now been unquestioned.

Previous to its employment, the advantage of working duplex over long cables was measured by an increase of from 60 to 65 per cent. in the working speed; since its adoption 90 to 100 per cent. is ordinarily attained. In addition to this, the facilities for arriving at and maintaining a balance are simpler and more efficient.

This latter point, when working busy circuits, is by no means so unimportant as has been stated.

Are not the difficulties and differences of opinion that exist with reference to this case occasioned more by a want of practical acquaintance with the subject, than by any points of a scientific character connected with it?

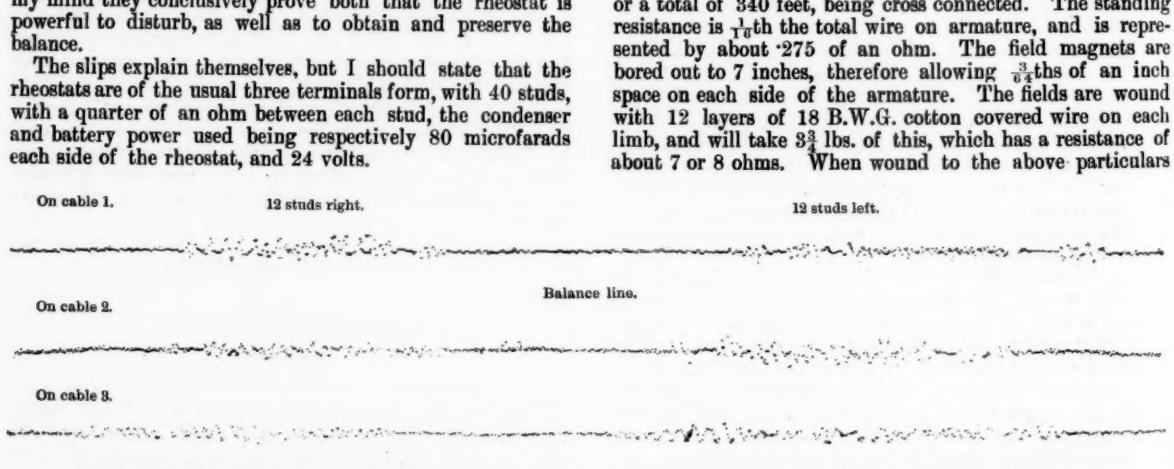
The paragraph dealing with the rheostat, and quoting the opinion of an "excellent authority," is so startling, and, moreover, so completely at variance with my own experience, that one is led to the conclusion either that this gentleman has had but little practice to guide him in the matter, or that he must be considered to be wilfully misleading both yourselves and your readers.

No one can seriously contend that the rheostat is anything but an extremely useful adjustment in the duplex circuit, and the assertion that the rheostat arm can be moved to any position without affecting the balance is a new fact, which surely can only apply to a duplex balance and circuit of an exceptional nature, and one which I am convinced is rarely met with in actual working.

I quite recognise that a bare statement to the above effect would be considered very inconclusive evidence, and having regard to this, I immediately wrote to two gentlemen who have charge of cable stations where duplex is used on several circuits, asking them to furnish me with slips obtained under the following conditions:—"Obtain the working balance when sending only, and note the stud on which the pointer of the rheostat rests, preserving the slip. Then move the rheostat 12 studs in either direction from the position of best balance; one slip should show the balance and the effect of the two changes made. If not too much trouble, I should like this done on all circuits, with a statement of condenser and battery power used."

These slips, by permission, I am now able to give, and to my mind they conclusively prove both that the rheostat is powerful to disturb, as well as to obtain and preserve the balance.

The slips explain themselves, but I should state that the rheostats are of the usual three terminals form, with 40 studs, with a quarter of an ohm between each stud, the condenser and battery power used being respectively 80 microfarads each side of the rheostat, and 24 volts.



The excursions of the syphon shown here, as produced by the movement of the rheostat, are ⅔rds of the actual size—sending during the whole tim .

In reply to my letter requesting that slips might be sent me, one of my correspondents made the following remarks. I have since obtained his permission to make them public.

He states:—"Of course, the person who says that the arm of the rheostat may be turned to any position without upsetting the signals and disturbing the balance, plainly shows his ignorance of submarine duplexing. Why, the mere turning from one stud to the next ($\frac{1}{40}\omega$) will, in some cases, give one a 'bad balance,' and cause the receiving fellow to growl."

Continuing, the same writer describes his "knowledge as unique, having actually been engaged on 23 duplexed cables, and practically overhauled another 13, which is a good record."

You will, perhaps, pardon me if I further emphasise my views by quoting another man's experience. The quotation is from a letter received by me on January 8th, 1895, and is dated Batavia (Java) December 6th, 1894, it follows from these dates that the remarks now under consideration, and published in the *Electrical Review* of January 11th, could not have been seen by either myself or my friend—nor is the duplex case referred to in the most distant way.

He says:—"The balance never gave us any serious trouble; but I did not realise for some time how great an influence the quarter ohm rheostat had upon it, and I do not yet understand why it has."

This letter replies, in some measure, to that signed G. H. Bailey in your last issue. I hesitate to give further consideration to the arguments which he, in all seriousness, put forward as dealing with the question in dispute. One is, however, disposed to ask this gentleman what his "common knowledge" of duplex was in 1880.

The whole case will, presumably, come before the Lords, and one believes that the patentees who succeeded in increasing by 100 per cent. the earning power of tens of millions sterling invested in cables, will have no reason to regret their appeal to the highest court.

I beg to thank you in anticipation for the insertion of this letter.

Arthur Dearlove.

Edison Phonograph Motor.

We have received the following letter which answers the enquiry made by a correspondent last week:—

The armature of the above motor (which is of the Pacinotti type) is composed of 13 rings (in fact, the more rings the better), with paper between each. Each ring is $\frac{1}{16}$th inch thick when riveted with the paper between it, and, with the paper between, it should be 1 inch on face. Brass rivets should be used.

The outside diameter is six $\frac{3}{32}$nds inch. The wire space is $\frac{3}{8}$ths inch wide and $\frac{1}{8}$th inch deep (it should not be less), and is wound with 22 B.W.G. double silk-covered wire. There are 40 sections, and each section is wound in three layers, nine turns on each layer, therefore 33 turns to each section, and wound like the ordinary Gramme ring, with the exception that the commutator is cross connected, so as to work with only two brushes, which are set at right angles.

About 8 feet 6 inches of wire can be got on each section, or a total of 340 feet, being cross connected. The standing resistance is $\frac{1}{16}$th the total wire on armature, and is represented by about ·275 of an ohm. The field magnets are bored out to 7 inches, therefore allowing $\frac{3}{64}$ths of an inch space on each side of the armature. The fields are wound with 12 layers of 18 B.W.G. cotton covered wire on each limb, and will take $3\frac{3}{4}$ lbs. of this, which has a resistance of about 7 or 8 ohms. When wound to the above particulars it will require no resistance in the circuit, but, if it be preferred to put in a resistance, use, say, one gauge thicker wire both for field and armature, with 27 turns instead of 33. The sizes given are before winding.

The fields are connected up in shunt with armature, and the governors are set so as to break circuit of armature only, and not the field magnet circuit. If well made, it should run the phonograph with $2\frac{1}{2}$ ampères at 2 volts, or 5 watts per hour. To add yet further particulars of the Edison motor, each cog of the armature projects $\frac{1}{8}$th inch, hence the wire space as above named. The diameter of the ring with the cog is $\frac{7}{16}$ths inch, or, including the cog, $\frac{9}{16}$ths inch. The armature (as preferred) can be made so as to turn all the current into useful energy, or, a resistance made use of, in

which trouble will be saved in winding. In the latter case, however, the motor would take a ½ ampère extra. Both modes are given in the above. The value of the separate rings first mentioned will be obvious, for if solid at this part, Foucault or eddy currents would be set up and cause heating in long runs. The fewer the separate pieces, therefore, the greater this latter liability. Always well insulate. Genuine Edison made castings can be purchased in this country, but there are very few reliable places from where they can be obtained. The best course is to apply to an authorised agent for one of the American Phonograph Companies.

A. Lomax.

Blackpool, *January* 21*st*, 1895.

Local Action in Accumulators.

In your issue of the 11th inst. an article appeared on the local action in storage batteries. The writer mentioned some experiments tried with peroxide of lead, formed by different methods, one by electrolytic action, the other mechanical and electrolytic combined; both are tested by means of platinum, and found to give the same E.M.F. Now it would be impossible for them to do otherwise, on account of having the same chemical action, with the same substance or active material, lead; but it is not possible, I mean from the point of cost, to use platinum for a grid, therefore it is no proof of what actually does take place; but I venture to say, and it can be easily proved, that although the E.M.F. would be the same, the capacity would not be alike. That is where the great difficulty comes in, to obtain capacity. The capacity of the applied peroxide is much greater, weight for weight, than the electrolytic peroxide. A plain piece of lead gives the full E.M.F., but there is no capacity. I see no use in experiments that cannot be actually carried out in practice. With zinc we can prove that peroxide of lead will give 2½ volts or more; but what use is it? it cannot be used, at least has not yet. A negative plate can be charged with zinc, but it cannot be used.

Local action is a very serious drawback at present, but it can be overcome by doing away with grids, and using solid plates. We want cells that can be run out without doing harm. The troubles are too numerous to mention, but they will be overcome in time.

E. Hancock.

Cost of Working at the Portsmouth Central Station.

In reviewing the working results at Portsmouth in your last issue, you incidentally compare those obtained at Bradford, and mention that a loss was sustained here for the first two years. In justice to the management, I think it well to state the primary cause whereby the said loss was incurred.

In the year 1889 electricity meters were in the experimental stage, and from those in process of development only two had been found at all reliable—the Aron and Edison. By influences over which I had no control, the corporation ordered largely of a meter relying upon commutator points dipping into mercury troughs, and as these contacts were quickly oxidised, the instruments speedily failed to register the current passing through them. Every possible effort was made, both by the makers and our own staff to overcome the difficulty, still it was found that the most strenuous exertions could not keep more than 60 per cent. of them going, and even those at a steadily declining speed after every re-amalgamation of the commutators.

Eventually, acting on my own responsibility, I replaced all of them at one stroke by the Aron meter, with the result that £1,500 profit was made for the half-year, as against £30 loss in the preceding half-year. This result being somewhat surprising, it was thought advisable to charge all wages belonging to capital account to revenue, so that only £970 was shown as a profit on revenue, and the price of current, which had been raised to 6d., was again reduced to 5d. per unit, at which price it still remains.

That the Bradford central station was thus heavily handicapped at the outset is at once obvious. Furthermore, at that date, the public had not gained confidence in electric lighting. Every man waited cautiously to see his neighbour make the experiment, and in this way a remunerative connection was but slowly gathered. All the more recent stations have the advantage of public confidence; money is forthcoming lavishly to erect handsome works filled with the most modern accessories and plant, arranged in such a manner that all future extensions can be readily added on. The disadvantage of being the pioneer station is still with us, and likely to be, from the fact of the works having been laid down on much too small a scale. To keep in operation a central station built on meagre lines, which has outgrown to a very large extent provision in mains, floor space, &c., presents problems and difficulties requiring untiring energy and perseverance to surmount, and in the end adds considerably to the cost of running.

It is a satisfactory sign of the times that municipalities are waking up to the advantage of starting from the outset on a liberal scale, and that the day of small beginnings is happily over.

Sydney W. Baynes.

Bradford Central Station, Yorkshire.

Correspondence.—We have received an interesting letter from Mr. B. H. Jenkinson on "Explosions," which we are compelled, owing to pressure upon our space, to hold over until next week.—Eds. Elec. Rev.

COMMUNICATION WITH AUSTRALASIA.

From the money article of last Tuesday's *Daily Telegraph* we extract the following:—"Rumours also prevailed of further difficulties in the Australian trade in connection with the fall in wool, though these reports were not confirmed. Telegraphic communication with the Antipodes has been suspended four days, owing to damage to the landlines at the other side." Our readers may remember that on the 18th of last month communication was broken down, owing to the landline across South Australia being interrupted, causing a delay of about a day in the transmission of telegrams. This unsatisfactory state of affairs will hardly bear out a statement made at the Ottawa conference by the Hon. Thomas Playford (the representative of South Australia). Mr. Playford, after deprecating the necessity of the Pacific cable, says, in reference to the existing means of telegraphic communication which Australasia has with Europe, Asia, Africa and America:—"We have, in every instance, duplicate, triplicate, quadruplicate, cable, the whole of the way; if one breaks down, there is another to rely upon; and so we have the best means of communication that we can possibly have at the present time." The present interruption, however, has the effect of reducing to an absurdity the above statement, which otherwise might have been treated simply as inaccurate. Indeed, the sweeping assertion above quoted, is to a great extent discounted by another sentence in the same speech, where Mr. Playford, in speaking of the Western Australian landline, which is the only alternative to that which runs from north to south through the colony which he represents, says: "Our line takes the whole of the messages; it is an easier line to work, running through the Continent from north to south, whereas the other line runs along the coast, and is more liable to be interrupted by thunderstorms and atmospheric causes." From this we are led to conclude that there is only one efficient landline connecting Australia with the submarine cables which land on her northern shores.

Our readers may remember that we have, at various times, had to call attention to the simultaneous collapse of the two submarine cables which connect Port Darwin (on the north coast of South Australia) with Java; and how, with the object of remedying these interruptions, a third cable was laid in 1889 between Java and Roebuck Bay (in Western Australia), there joining the Western Australian landline. Now Port Darwin is the northern terminus of the South Australian landline, which, according to Mr. Playford, "takes the whole of the messages"; thus we have the two indifferent cables connected with what appears to be the only efficient landline. As opposed to this, we have the recently laid auxiliary cable (which has only broken down once) connected at Roebuck Bay with a landline which is apparently not adapted to every-day work. This combination may be

described as unfortunate; and we have little doubt that, on consideration, Mr. Playford would agree with us in this opinion.

We have no wish either to ignore or to minimise the plucky work done by South Australia in 1870, when, with a population little exceeding 200,000, that colony undertook single-handed the construction of a landline about 2,000 miles from south to north, across what was then an unexplored country. This line was completed in 1872 at a cost of over £500,000, and by its means telegraphic communication between Europe and Australia was rendered possible. While quite recognising the enterprise displayed in this work, we cannot, in view of the periodical recurrence of interruptions to Australasian traffic, do otherwise than maintain the opinion which we have so frequently advanced: that until the Pacific cable has been laid, our means of communication with these colonies is incomplete and insecure, even in time of peace.

NOTES.

Lord Kelvin on Technical Training.—Lord Kelvin, president of the Royal Society, distributing the prizes at the Mechanics' Institute, Crewe, last Friday night, said the objects of technical training were manifold. Technical training not only offered facilities to them in earning their livelihood, but afforded them knowledge which made life worth living. He believed every workman who felt interested in his work, whose mind was occupied while his hands were at work, would have a happier life than the workman whose mind was a blank. Technical schools offered the rising generation enormous advantages, but while technical colleges could not create men like George Stephenson, they gave every man a chance of using to the utmost his natural faculties. In going through Crewe works that day, he was much struck with the new electrical development which was taking place. He himself took an intense interest in electricity early in life, and he had never ceased to take an interest in it, therefore it had been the greatest possible pleasure to him to see electrical science brought out from mere book science and from the science of the university laboratories to be a great auxiliary in the work of mankind. It was a great pleasure to him to hear that electricity was doing such good work all over the world. Ten years ago scientific workers could hardly have dreamed of this. He did not predict that it would come to pass immediately, but he thought it possible that steam locomotion might be superseded on their railways by electricity. Mr. Webb, locomotive superintendent of the North-Western Railway, in an address, said that if the company gave instructions to have electric trains, he would undertake to have one ready within two months. Surely both Lord Kelvin and Mr. Webb were dreaming, and only dreaming, of the substitution of electricity for the steam locomotive on trunk lines?

Brussels Electric Lighting.—The electric light in this town is now becoming widely adopted, necessitating an increase of plant at the central station; the order for a third unit has been placed with the India-Rubber Company, of Silvertown, and it is expected that this will be erected and ready early next month. Each unit is composed of one 600-H.P. slow speed compound condenser engine, and two continuous current low tension dynamos, the distribution being on the three-wire system; to meet this addition of machinery, the boiler plant is also being extended. The demand for light in the upper part of the town having exceeded expectation, it has been decided to erect there an independent station, and the same company, acting as general contractors to the town, have been instructed to supply and erect the necessary plant, consisting of two 130-H.P. gas engines, dynamos, cables, switchboard, &c., to meet the immediate requirements. This satisfactory progress is no doubt due to the fact that the returns for the year's working already show a profit, although it will be remembered that the central station has only been working for little more than one year. The India-Rubber, Gutta-Percha and Telegraph Works Company are to be congratulated upon such satisfactory results.

Lectures.—A popular lecture on "Electricity," illustrated by numerous experiments, was delivered on Saturday evening last at the Polytechnic, Thornton Heath, Croydon, by Mr. W. Perren Maycock, M.I.E.E.

Prof. J. A. Fleming lectured at Ashford, on Monday last, on "Magnetism."

Before the Ipswich Scientific Society, on Wednesday, last week, the president (Mr. S. A. Notcutt) interested the members with experiments on electrical waves.

In Iredale's Lecture Room, at Torquay, last week, Mr. T. Viccars, F.G.S., commenced a course of three Christmas Vacation University Extension Lectures upon "Electricity and Magnetism."

The Incandescent Gas Light.—On this subject we have received a note in reply to Mr. E. H. Welsh's letter in our issue before last; but as it is somewhat personal, we do not, for obvious reasons, publish it. Is it not a fact, however, that Mr. Welsh represents the Welsbach Company in Belfast, and that he is their paid servant? In regard to the remedy proposed by Mr. Welsh for the unsatisfactory colour of the light—viz., the use of an opal chimney and coloured globes—it is, perhaps, almost needless to point out that this makeshift may cut off the "greenery-yellery" tinge, but it also most certainly cuts off from 50 to 60 per cent. of the total light. In fact, the use of these coloured globes and chimneys reduces the boasted 50 C.P. to that of an ordinary gas jet, which requires neither chimney nor globe, except for appearance sake.

The Mordey Alternators.—With reference to our recent remarks regarding these alternators, we have pleasure in making the following extracts from a letter recently received from Mr. James T. Cornish, who is in charge of the central electric lighting station at Sao Paulo, Brazil. The writer says: "It may interest you to know that during a recent drought I repeatedly ran a Mordey alternator for some hours at 700 revolutions, giving 23·5 ampères at 2,300 volts. Not having enough water for two turbines, the only way to keep the lights going was to throw all the load on to one dynamo. It stood it splendidly, although 30 per cent. overloaded, the ring just getting a little warm. Our parallel running has been most successful, although we have no governors whatever, all regulation being done by hand on the turbine. Are not these conditions altogether against good parallel work? The synchronising current seldom appears to be much."

New Paper.—We have received a copy of a new journal, known as *Electrical Discovery*, published fortnightly in London. It is intended to deal exclusively with new patents that come out from time to time.

Satisfactory Settlement of the Battery Litigation.—We are informed by the Chloride Electrical Storage Syndicate, Limited, that the recent litigation or disputes between themselves and the Electrical Power Storage Company, and the Electrical Construction Company, Limited, have been settled on mutually satisfactory terms, and that the Chloride Company continue to make and sell their batteries as heretofore.

Marriage.—Mr. A. J. Mayne, partner in the firm of Messrs. New & Mayne, was married at Frimley, on the 8th inst., to Miss Florence Maud Pain, daughter of Mr. and Mrs. Frank Pain, of Woodside, Frimley.

Alleged Defective Wiring at the Savoy Theatre.—It is said that a trombone player belonging to the orchestra at the Savoy Theatre placed his instrument in a corner of the orchestra on leaving the theatre on Saturday afternoon, and on returning found that it had been practically fused through contact with some of the electric wires. How it could happen that the wires should be left in such a condition that a brass instrument was fused through contact therewith we cannot understand. It is a wonder the results were not more disastrous.

Programme Advertisements.—A correspondent of the *Times* complains of the great number of advertisements (including those of electrical belts) printed over what are supposed to be theatre programmes.

Explosions in Main Boxes.—Yet another main box explosion has occurred in the London district, this time within the area supplied by the St. James's and Pall Mall Electric Light Company, Limited. The explosion which happened on Friday afternoon last at the bottom of St. James's Street, opposite the Thatched House Club, was accompanied by a loud report, the iron lid of a manhole being blown off. Fortunately no one was injured. Paragraphs in the daily press say that "the occurrence is supposed to have originated in the electric light mains." We understand the officials of the St. James's Company are making an inquiry into the explosion. We also cull the following paragraph from the *Evening News* of Saturday last upon the subject of these explosions:—"In view of the frequency with which explosions occur at the manholes of the electric light mains passing along the public thoroughfares, a petition is being prepared for presentation to the Board of Trade, urging that some immediate measures should be taken to cope with this alarming source of danger to the public."

City and Guilds of London Institute.—The annual distribution of prizes to the successful students of the colleges and schools founded and maintained by the Institute, took place on Thursday evening last, January 17th. The Marquis of Lorne presented the awards (and also presided in the absence of the Lord Mayor, who was unable to be present).

Personal.—We hear that Mr. Frank Bailey, of the Metropolitan Electric Light Company, has been appointed engineer to the City of London Electric Lighting Company. Mr. J. Cecil Bull, the secretary, has taken over, as well, the duties of Commercial Manager. Mr. Frank Bailey will retain his position as engineer to the Metropolitan Electric Light Company.

Cable Duplex Working.—With reference to our recent leader on "Muirhead *v.* The Commercial Cable Company," we would draw attention to an interesting letter in our Correspondence columns, by Mr. A. Dearlove, on Cable Duplex Working.

Blackburn Electric Lighting.—At a recent meeting of the Gas Committee of the Blackburn Corporation, Mr. A. S. Giles was appointed borough electrical engineer. The work at the central station, which is being carried out under the superintendence of Mr. E. M. Lucy, who was appointed consulting engineer last September, is nearing completion, and the Corporation expect to be in a position to supply current to consumers in about three weeks. Already applications for upwards of 1,800 lights have been received.

Church Lighting.—St. Peter's Church, Eaton Square, is now lighted with electricity. It is a feature of the scheme to utilise the reflecting power of the light colours on the surrounding surfaces in order to obtain an equal diffusion of light, and to avoid an otherwise prodigal waste of lights, while at the same time hiding the actual lights from the direct vision of the congregation as much as possible. When the additions and alterations to the edifice which are in progress are completed, there will be some 260 16-C.P. lamps, replacing some 640 gas burners previously in use. The scheme of lighting is from the designs of Mr. W. Howard Tasker, M.Inst.E.E., of Kensington, who prepared the plans and specification, and under whose supervision the work was carried out. Messrs. Moody Bros., of Westminster, secured the contract.

Society of Arts.—On Monday next, January 28th, at 8 p.m., Prof. S. P. Thompson will deliver his third Cantor lecture on "The Arc Light." He will deal with: "Arc lamp mechanism—The requirements to be met, and methods of fulfilling them—Alternate current lamps—Special lamps—Qualities of carbons—Accessories."

Cooking by Electricity.—*Black and White* for January 12th gives an interesting account of Miss Fairclough's recently established School of Cookery, in which electrical cooking apparatus is employed. The school is situated in Gloucester Road, almost adjoining the station, and it is claimed that it is the first school of cookery in which electricity was used for cooking purposes. Messrs. Crompton and Co. had the order to fit up the school, and during the last few months the apparatus has been at regular work, with very successful results.

The Mattei Remedies.—The following extract from the *Notts Guardian*, of January 16th, is a fitting commentary on our leading article of January 11th:—"At the previous Worksop County Court, before Judge Masterman, a lady named Blakeley, who lives at 'The Mattei Depôt,' Newcastle Avenue, Worksop, sued a number of Worksop and district residents for sums of money which she alleged were due to her for medicines supplied. At the hearing of the case it appeared that the plaintiff had represented herself as a doctor, and had dispensed the Mattei remedies. A young lady, named Nelly Pinder, who appeared for the plaintiff, said the prescriptions were made up by herself, and they did not, according to her belief, contain poison. His honour then adjourned the case in order to have the medicine analysed, and commenting on the fact that unlicensed persons were allowed to dispense things of this sort, he said that if allowed by law it was a source of danger to the public at large. At the first hearing several of the people who were sued alleged that the whole thing was a fraud. The plaintiff was, at the resumed hearing on Tuesday last, represented by Mr. A. Charles, of Retford, who stated that the whole of the cases entered into at the previous court were now withdrawn, and one of the defendants from Carlton-in-Lindrick asked for costs, and this Mr. Charles opposed on the ground that notice had been given the defendant, who need not have come, and his Honour said it was very likely he should not allow costs for the day, but whether he ought to have the costs of the previous attendance he would decide later. Mr. Charles said his client being a woman was ignorant of the mode of procedure, and also of the law, when she brought the action, but she had since been advised, and it was seen that she was wrong. His Honour said from the analysis made by the county analyst, the contents of the bottles handed to him at the previous court consisted only of tap water, and if that had been given in evidence before him he should certainly not have found for the plaintiff. Mr. Charles again said that his client had no cause of action. His Honour said plaintiff must pay for going outside the law. He allowed the defendants who appeared the costs for attending the previous Court. His Honour further remarked that the county analyst failed to find anything in the bottles except tap water, and was also satisfied that there was no appreciable medicinal active ingredient. He also said that it should be remembered that it was not proved before him that the liquid in the bottle really was the medicine dispensed. It was simply handed to him by one of the defendants."

NEW COMPANIES REGISTERED.

Magic Box, Limited (42,929).—This company was registered on the 3rd inst., with a capital of £5,000 in £1 shares (2,500 preference and 2,500 deferred), to enter into a certain agreement to acquire and work any patents for any purposes whatever, and to carry on the business of machine and other manufacturers, electricians, mechanical engineers, suppliers of electric steam, pneumatic or other forces for the purposes of light, heat, motive power, or otherwise. The subscribers (with one share each) are:—C. Jones, 6, St. John's Park, Blackheath, S.E., major; F. E. D. Acland, Dock House, Billiter Street, E.C., civil engineer; J. G. Accles, 41, Craven Street, W.C., engineer; A. G. Ross, 85, Onslow Square, S.W., gentleman; B. F. N. Macrorie, Dock House, E.C., secretary; H. G. Stephenson, 31, Lombard Street, E.C., solicitor; C. Mackintosh, 4, Wetherby Gardens, S.W., gentleman. La Boite Magique, Limited, are entitled to appoint from time to time two directors of the company. There are never to be more than five directors. Qualification 100 shares; remuneration to be fixed in general meeting. Registered by Harwood & Stephenson, 31, Lombard Street, E.C.

Stirling Boiler Manufacturing Company, Limited (43,016).—This company was registered on the 15th inst. with a capital of £60,000 in £1 shares, to carry on the trades of engineers, boiler makers, suppliers of electricity, light, heat, and motive power; and to adopt an agreement made between the International Boiler Company, Limited, A. Stirling, and W. R. Wills, relative to the right to manufacture and sell Stirling boilers. The subscribers are:—

F. H. Hornblower, 17, Baltic Buildings, Redcross Street, Liverpool, iron merchant, 125 shares; T. B. Bentley, 10, Dale Street, Liverpool, agent, 100 shares; W. R. Wills, 18, Baltic Buildings, Liverpool, engineer, 125 shares; E. Storey, 10, Victoria Street, Liverpool, colliery owner, 250 shares; E. Hawkins, 284, Hagley Road, Birmingham, manufacturer, 250 shares; G. H. Johnstone, 4, Queen Street, Liverpool, iron merchant, 63 shares; J. M. Young, 4, Queen Street, Liverpool, merchant, 62 shares. There are never to be more than seven directors. Qualification £125; remuneration to be fixed in general meeting. Registered by T. T. Hull, 122, Chancery Lane, W.C.

Thomas Broadbent & Sons, Limited (42,017).—This company was registered on the 15th inst. with a capital of £25,000, in £10 shares (500 preference and 2,000 ordinary), to carry on the business of machine makers, electrical engineers, contractors, builders, structural ironworks makers, patentees of machinery and other utensils, and manufacturers of and dealers in all classes of machinery, utensils, commodities, mill furnishings and other similar requisites. The subscribers (with one share each) are:—W. Broadbent, Central Iron Works, Huddersfield, engineer; H. Broadbent, Central Iron Works, Huddersfield, engineer; A. Drake, Moldgreen, Huddersfield, cashier; J. Blackburn, 18, South Parade, Huddersfield, manager; H. Broadbent, Huddersfield, widow; W. H. Thorpe, Halifax, commercial traveller; A. H. Hardesty, Huddersfield, clerk. The first directors are Wm. Broadbent and H. Broadbent. Qualification, 100 shares; remuneration not yet determined. Registered by Jordan and Sons, 120 Chancery Lane, W.C. Registered office, Vulcan Street, Huddersfield, Yorks.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Telegraph Improvement Company, Limited (15,475).—This company's last return, filed December 29th, 1894, shows that out of a nominal capital of £100,000, in £1 shares, 15,006 shares have been taken up, and that £1 has been called and paid on each of six shares. The sum of £15,000 has been agreed to be considered as paid.

Venezuela Telephone and Electrical Appliances Company, Limited (31,305).—This company's last return shows that out of a nominal capital of £70,000, in £1 shares, the whole of the shares have been taken up, and that the full amount has been called and paid on each of 13,494 shares. A sum of £56,506 has been agreed to be considered as paid.

Morecambe Electric Light and Power Company, Limited (34,488).—This company has filed its yearly return, which shows that out of a nominal capital of £15,000, in £1 shares (14,950 ordinary and 50 founders'), 6,702 ordinary, and the whole of the founders' shares, have been taken up, and that the full amount has been called on all the founders' and each of 5,941 ordinary. A sum of £5,903 15s. has been received, £761 has been agreed to be considered as paid, £99 is outstanding, and £11 15s. is the amount paid on 118 shares forfeited.

Isle of Wight Electric Lighting Company, Limited (35,171).—This company's annual return shows that out of a nominal capital of £1,000 in £1 shares (940 ordinary and 60 founders'), seven shares only have been taken up. Nothing has been called or paid.

Lancashire and Yorkshire Electric Lighting Company, Limited (17,486).—This company's last return shows that out of a nominal capital of £100,000, in £5 shares, 127 shares have been taken up, and that £2 10s. has been called on each. A sum of £315 has been received, and £2 10s. is outstanding.

Railway Automatic Electric Light Syndicate, Limited (28,332).—This company filed its yearly return on the 15th inst., which shows that out of a nominal capital of £25,000, in 400 ordinary and 600 preference £25 shares, the whole of the preference and 396 of the ordinary shares have been taken up, and that £20 has been called on each of 200 ordinary and 550 preference, and £20 on each of 50 preference. The sum of £18,103 has been received, £5,000 has been agreed to be considered as paid, £1,592 is outstanding, and £45 has been paid on four forfeited shares.

Irish House-to-House Electricity Company, Limited (29,226).—This company's last annual return, filed on January 7th, 1895, shows that out of a nominal capital of £100,000, in 19,900 ordinary and 100 founders' £5 shares, 100 founders' and 527 ordinary shares have been taken up, and that 10s. per share has been called on each of the latter. A sum of £202 has been received, £500 has been agreed to be considered as paid, and £61 10s. is outstanding.

United States Power Syndicate, Limited (33,457).—This company filed its yearly return on January 4th, 1895, which shows that out of a nominal capital of £70,000, in £10 shares (2,000 preference and 5,000 ordinary), 396 preference and 3,500 ordinary shares have been taken up. There has been £7 10s. called on each of 390 preference, and £10 on each of £2,000 ordinary shares. A sum of £22,975 has been received, £15,000 has been agreed to be considered as paid, and £50 is the amount of calls paid in advance.

Italian Electrical Light and Power Company, Limited (34,433).—This company filed its yearly return on November 29th last. It shows that out of a nominal capital of £60,000, in £4 shares, 307 shares have been taken up. Nothing has been called, but £1,200 has been agreed to be considered as paid on 1,200 shares.

Marveilleuse Electric Arc Lamp Syndicate, Limited (38,699).—This company's last annual return, filed February 20th, 1894, shows that out of a nominal capital of £15,000, in £1 shares, 9,807 shares have been taken up, and that the full amount has been called on 807 of these. A sum of £425 has been received; £9,000 has been agreed to be considered as paid; and £382 is outstanding.

Lamina Accumulator Syndicate (Elieson's British Patents), Limited (39,144).—This company's yearly return was filed on January 3rd, 1895, which shows that out of a nominal capital of £12,000 in £1 shares, 10,007 shares have been taken up, and that 15s. has been called on each of 3,757 of these. A sum of £2,737 10s. has been received, £6,250 has been agreed to be considered as paid, £80 5s. is in arrear.

Elmore's Foreign and Colonial Patent Copper-Depositing Company, Limited (29,095).—This company's registered office is now at 13, Bond Street, Leeds.

Globe Electric Company, Limited (35,123).—This company's registered office is now at 8, Wells Street, Oxford Street, W.

BUSINESS NOTICES, &c.

Aberdeen.—Dissatisfaction has been expressed with the Corporation charges per unit, and for meter rents. The Council are looking into the matter with a view to making reductions.

Ashton.—Nothing has been included in the Town Council's estimates for the year 1895 for electric lighting purposes. There is a desire among the members for the light, and the Mayor the other day ventured to suggest that perhaps there might be an expenditure next year. Information which has been collected upon electric lighting matters is shortly to be made known to the Council.

Australia.—The inhabitants of Adelaide have been polled to decide whether the city should be lighted by gas or electricity. The result of the polling was 3,382 votes in favour of gas, and 2,255 for electricity.

Bedford.—Experiments are being conducted by the Council regarding the suitability of electricity for lighting the streets.

Belfast.—The electric current was turned on on Wednesday, 23rd inst., shortly after sunset.

Brighton.—The Council has accepted the offer of the successors to Messrs. Latimer Clark & Co. (the Wigston Electrical and Engineering Company) to supply them with the repaired field magnet coil for £40.

Bristol.—In regard to our statement about the electric lighting of St Mary's Church, Redcliffe, we are informed that this was not quite correct. Messrs. F. W. Ball & Co., who carried out the installation, state that it consisted of 20 16-C.P. lamps on each of the four arches; they are now putting 20 16-C.P. lamps on each of four more arches.

A large number of tenders have been received for lighting the Guildhall by electricity. The mayor and electrical engineer are to open and summarise them and report.

Cardiff.—Current was turned on in the Town Hall on Thursday night last week, for the first time, on the occasion of the Mayor's banquet. The work has been carried out by Messrs. Fergus and Co., of Cardiff. The lighting consists of about 400 lights. From the main switchboard the current is divided into 11 main circuits as follows:—Main corridor and vestibule, grand jury room, mayor's parlour, &c.; crown court, nisi prius court, borough engineer's offices, town clerk's offices, assembly room, council chamber, police-court, police-station, magistrates' clerk's offices. The illumination of the assembly-room is obtained by 60 lamps suspended from the ceiling, and by brackets arranged round the walls of the room. Messrs. Fergus & Co. have also in hand for the Corporation of Cardiff installations at the borough treasurer's offices and public markets.

Dundee.—Mr. Geo. Baxter, the Council's water engineer, has recently reported upon schemes for the utilisation of water-power within the district. Under the heading of "Water to drive Turbines for Electric Light," he says:—"The power required at the electric lighting station is fully 700 horse-power, and the power that might be obtained by the fall of our water into Stobsmuir would not exceed 9 horse-power. I may point out that the question of water-power for the electric lighting of the city was fully considered by the previous Convener when the scheme was in hand, and, so far as the public water supply was concerned, it did not require very serious consideration to arrive at the opinion that no help could be derived from it."

Fareham.—An extraordinary meeting of the Local Board was held on Monday at the Foresters' Hall, when the question of the proposed purchase was again considered.

Hastings.—In a note at the bottom of page 48 of our issue of January 11th, we stated, according to the *Hastings Times*, that the electric light along the sea front has on frequent occasions recently gone out, leaving the place in darkness. A correspondent, who has taken some pains to learn the truth of the matter from the Hastings Electric Light Company, has ascertained clearly that while the extinctions have, in fact, taken place once or twice, they have not been due to any electrical defect in the dynamos or lamps in use by the company, but solely to the fact of the company having their plant overloaded, and to their having deliberately switched out the lamps on the sea front in consequence, to prevent injury to the plant by excessive overload. It seems that the company have been in expectation for some little time past of getting their extension plant, now nearly finished, to work, and have been making connections to customers in anticipation. Owing to delay in delivery of steam pipes, they have not yet been able to get their extension plant to work, although they expect to do so in the course of a few days. Meantime, they have been suffering from the effects of a larger demand than their plant could meet, and have had to switch out circuits here and there, to keep things going.

Hertfordshire.—The electric light is on the increase in the county of Hertfordshire. There are now, we are informed, a great many private installations throughout the county, the most extensive being Messrs. John Dickinson & Co.'s paper mills at Croxley. This firm have an installation capable of supplying 2,400 lights of 16 C.P. The plant comprises two Mather & Platt dynamos, and one Siemens dynamo, the latter being supplied twelve months ago by Messrs. Drake & Gorham; there is also a Sims & Armington high speed engine. The plant is so arranged that either the large dynamo, or the two smaller ones, may be run. The power for driving the plant is derived from the main engine, which drives the machinery throughout the mill; but in the event of this having to shut for repairs or mill purposes, there can be brought into use an Armington and Sims engine. The number of lights distributed about the mills at present reach over 1,000, many of these being 100 C.P. The whole of the lighting arrangements are under the superintendence of Mr. R. Stacey.

Hull.—Since the opening of the central station in January, 1893, to supply the Old Town of Hull, there has been an increasing demand for current. The following table, which has just been published by the Corporation, shows the growth during last year.

	Year ending 1893.	Year ending 1894.
Engines	560 H.P.	860 H.P.
Dynamos	2,600 ampères.	4,200 ampères.
Condensers	——	500 H.P.
Battery	920 ampère hours.	920 ampère-hours.
Street conduits ...	2¾ miles.	5½ miles.
Cables laid	9¾ „	21½ miles.
Lamps attached ...	8,035 = 8 C.P.	14,208 = 8 C.P.
Units delivered ...	74,600	163,357.
Users...	1 8	271.
Price per unit ...	7d. for lighting. 6d. for motive power	6½d., lighting. 5½d., places of worship 5d., motive power.

Owing to the demand, the supply was extended west of the Docks at the latter part of 1893. The complete equipment of the station and service in 1893 cost £23,072, the additions bringing its present cost to near £40,000. On Thursday last week, January 17th, on the occasion of the visit of the Hull and District Institute of Engineers and Naval Architects to the Coporation station, the starting of a new 300 H.P. engine and dynamo which has been rendered necessary by the large demand, also took place, the mayor performing the ceremony. The sheriff immediately after started the new motor generator. Since the introduction of electric lighting here, it will be seen from the figures given above that there has been a reduction in the charge per unit from 7d. to 6½d. for lighting, and 5½d. per unit for places of worship, and from 6d. to 5d. for motive power. Mr. Holder, the chairman of the Electric Lighting Company, in the course of his remarks at last week's gathering, gave the following details regarding the working: They made up their accounts on December 31st, and, therefore, their second year had just been completed. In their first year they delivered 74,000 units of electricity, and during the second year they had increased that by more than 100 per cent., their delivery being 163,000 units. Their income for the first year was about £2,200; last year, at a lessened charge, it was £4,800. In their first year they paid their way in an extraordinary degree, and Hull held the record of England for economical working. They paid every penny for upkeep, maintenance, taxes, interest, and everything, and had the nice little sum of £130 profit. The second year had been better. The accounts were not fully made out, but he had gone through the matter carefully in his own mind, and it enabled him to say they had done exceedingly better, and would hold the record for economical working against any station which had been in existence for that time. They would not only be able to pay up-keep, interest, &c., but a twenty-fifth part of their capital, and have a few hundreds of pounds profit. He had been asked to give the reasons of the success of the station. He alluded to the benefit derived from having practical men on the electric lighting committee; through these men they were persuaded to have the best plant; further, they had been successful in securing in Mr. Harman Lewis and Mr. A. H. Gibbings, two of the best central station engineers in the country. He believed the fact of their having good plant, instead of cheap stuff, had led to the economical working. Mr. Gibbings having made a few remarks, the visitors proceeded to inspect the station machinery, and the serving of refreshments, accompanied by the usual compliments, terminated the proceedings.

Leicester.—The electric light has been introduced into Bishop Street Church, Leicester, at a cost of £160.

Liverpool.—The Health Committee of the Corporation have instructed the city engineer to report as to the further utilisation of the heat generated at the refuse destructor works, in Chisenhale Street. The proposer of the resolution to this effect thought it might be used for supplying electricity for lighting the Corporation buildings.

The Corporation Finance Committee have instructed the surveyor to report upon the cost of lighting St. George's Hall by electricity, and the establishment of a supply station under the hall.

London.—The St. George's Vestry has agreed to ask the Board of Trade not to sanction large transforming electric chambers in the public highway, such being regarded as dangerous.

Montrose.—The Town Council last week confirmed a previous resolution of the council to support the House-to-House Electric Lighting Company in its application for a provisional order.

Moss-Side.—At the last meeting of the District Council the clerk read correspondence between himself and a new company in course of formation, which proposes to take over the concession granted to another company for the lighting of the district by electric light. He explained that he had asked for more information to be supplied to him about the new company before the sanction of the council could be given.

New Swindon.—The District Council has appointed a committee to consider the electric lighting question.

Rottingdean.—As we understand that Rottingdean is considering the question of electric light, it is interesting to note that Messrs. New & Mayne have put down there a temporary plant, consisting of Babcock-Wilcox boiler and Parsons combined steam turbine direct current dynamo, which will be started in a few days. They have put 150 lights into Messrs. Mason's College, and have applications for 300 more lights in the vicinity, which are being put in as rapidly as possible. It is the firm's intention in the summer to put down a permanent plant driven by wind power, using steam only as an auxiliary.

Scarborough.—The Town Council have asked the Scarborough Electric Supply Company, Limited, to tender for lighting certain streets by electricity. The Electric Lighting Subcommittee presented a report from Mr. B. Drake, who stated that, in accordance with their instructions, he had made a personal inspection of the Scarborough lighting station, and was pleased to say that he found it in a generally satisfactory condition. He recommended that another engine and fan should be provided as duplicate to the present one, for at present, if anything happens to either the small vertical engine or fan, the ventilation would not be maintained. Mr. Drake added:—"The importance of this was brought home to me a few weeks back at Portsmouth, where I was called upon by the Bank of England to report upon a series of explosions which had taken place under the pavement opposite to the Bank premises. These were found to be due to the accumulation of coal gas from defective gas mains, and there is no doubt that the gas would have been driven off innocuously had there been a proper system of forced ventilation. My recommendation that the terminals carrying the live wires should be painted red has not been carried out. I consider this of importance, for I gather that it is not always the terminal in the same position which is connected to the leading in wire, so that the attendants might very easily make a mistake when making connections. I am informed that on a few occasions there has been a cessation of service to the town. This was due in one case, I am told, to the seating of the main steam valves becoming dislodged, and steps have been taken

to prevent a recurrence. In another instance an attendant forgot to switch on the lights to part of the town, and in a third there appears to have been only one man at the station, and he met with a slight accident near the boilers. Considering the time the lights have been on, and the fact that the apparatus was new throughout, I consider that the result of the working, up to the present, is very satisfactory, and I need hardly point out that as the demand increases there will be more machines at work and a larger staff in attendance, so that break-downs would be less likely to occur. I think, however, that the corporation would not be unreasonable in asking that there should at all times of the day and night be more than one attendant at the central station. The committee recommended that the Town Clerk be instructed to send a copy of the foregoing report to the Scarborough Electric Supply Company, Limited, and ask that the recommendations therein contained be carried out forthwith.

Sheffield.—The new generating plant which has been laid down for the Sheffield Electric Light and Power Company, has now been satisfactorily started to work at the company's central station. The machine will supply 10,000 lamps, and occupy an extremely small floor space. All belts and ropes are dispensed with. The lubrication is automatic, and in the entire machine there are only two main bearings. The armature is mounted on the rim of the fly-wheel, and the fly-wheel is hung on the crank shaft between the two upright cylinders. The designers and contractors are Messrs. S. Z. de Ferranti, Limited. The machine is a "300-kilowatt direct coupled steam alternator." The engines are vertical compound, and have been made by Messrs. Browett, Lindley & Co. The cylinders are 19½ and 32½ inches in diameter respectively, and the stroke is 20 inches. The engines work at a steam pressure of 140 lbs., and are capable of giving 450 brake horse-power when working non-condensing at a speed of 150 revolutions per minute. The automatic shaft governor, which acts directly on the cut-off valve of the H.P. cylinder, is also by Messrs. Browett, Lindley & Co. The fly-wheel, which is 12 feet 6 inches in diameter and 10 tons in weight, is carried on a massive steel shaft, 12 inches diameter in the centre and 9 inches in the bearings, and on which two cast-steel crank discs are shrunk und keyed. On the rim of the fly-wheel is mounted the armature of the machine, which consists of 40 pairs of bobbins wound of copper tape and insulation, the whole being of very rigid construction. Each pair of bobbins is solidly riveted between two heavy gun-metal brackets or clamps, and these brackets are in turn secured to the armature wheel by means of steel insulated bolts projecting considerably from the rim. The entire armature is thus carried by 80 spokes, and is of great lateral strength, the windings of each bobbin being tied together by a corrugation carried right through its whole section. The armature revolves between two massive cast-iron frames, each of which support 80 electro-magnets, the weight of each complete frame being 5½ tons. The frames themselves consist of heavy castings, in each of which are placed 80 wrought-iron cores or pole pieces, each fitting in an accurately machined 3½-inch hole. On each of these cores is placed a field magnet coil, consisting of copper tape wound on edge, according to Messrs. Ferranti's latest design, which, while allowing the greatest amount of copper to be placed in the smallest space, gives very efficient insulation and large radiating surface. The bearings and crank-pins are of swivel type, so as to allow of their always taking up the position allowing the greatest bearing surface and support to the shaft. The bearings consist of cast-iron, lined with white metal, and each bearing and crank-pin is lubricated by two methods, one by the ordinary sight-feed drip lubricator, supplied from a reservoir, and secondly, by means of a force pump driven from the crank-pin on either side, which gives a continuous circulation under pressure at the bottom of the bearings, and to the centre of the crank-pins. The output of the dynamo is 150 ampères at 2,000 volts at 100 periods. The steam consumption of the engine is 23 lbs. of steam at full load when non-condensing.

Southampton.—As Messrs. Crompton & Co. are carrying out the electric lighting of the old Town Quay, the Harbour Board asked them to tender for the electric lighting of the Quay extensions. Their estimate amounted to £399 18s. Mr. Aldridge, the consulting engineer, estimates the work can be done for £335, and the Harbour Board has resolved to do the work themselves.

Wakefield.—The electric lighting minutes passed by the Council recently, showed that Mr. Robert Hammond had attended before the committee, and explained his report *re* the electric lighting of the city. The committee had decided, before proceeding further in the matter, to visit and inspect electricity works in operation at other places. The Cathedral authorities are anxious to have the light on there, and have inquired, through their secretary, as to when the light is likely to be ready.

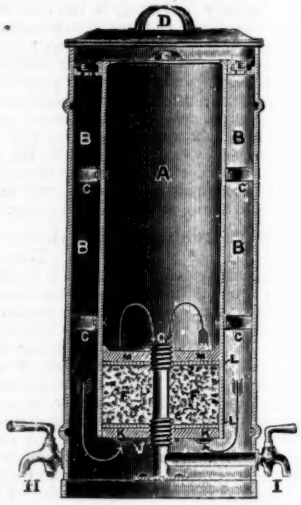
Wells.—At the last Town Council meeting letters were read from the agents to Mr. Brown, electrical engineer, stating that they had been in communication with the Board of Trade, who had written that, while not declining to grant a license for electric lighting in Wells, they were prepared, if application were made, to issue a provisional order. The matter was shelved until the draft of the agreement with Mr. Brown is laid before the Council by the Town Clerk.

Wolverhampton.—The Mayor, replying to a member of the Council the other day, remarked that when he said that their contracts were to have been completed by September 1st, and that an extension of time was given, they might reasonably suppose the electric light would have been installed long before the present time. But it was absolutely of no use—it would be suicidal—for the committee to take over the works until they were satisfactorily completed. It was absolutely essential that a complete test should be made for at least a week before they took over the whole of the delicate machinery, and lighted the town. Arrangements had been made for tests, but they had not been completed. If those tests were satisfactory the town would be lighted at an early date.

Another Electric Signal Lamp.—We learn from the *Western Morning News* that a new electric signal lamp has been submitted to the Admiralty, and "as a result of the experiments to which it has been subjected it stands a good chance of replacing the multiple fibre lamp now in use on many vessels. The new lamp is partially charged with hydro-carbon vapour instead of, as is the case in all the other types, generating its incandescence in a vacuum. Several of them have been sent to Captain J. E. Meryon, of the *Defiance*, torpedo schoolship at Devonport, for the purpose of a series of experiments, which will be carried out under the joint direction of Flag-Captain Bouverie F. Clark, Royal Naval Barracks; Captain R. H. Hamond, Cambridge; and Captain J. E. Meryon, who have been requested to report the results at the earliest opportunity. The experiments will be interesting, as the hydro-carbon lamp will be tried against the multiple fibre type of 16 candle-power, the comparative tests being for clearness, brilliancy of light, and speed in signalling. The main object of the experiments will be to ascertain how rapidly the new lamp can be distinctly flashed, and if in this respect it surpasses the multiple fibre lamp its adoption for service use is certain, even if the brilliancy of its light is less than that of the multiple fibre pattern."

Auction Sale.—On Wednesday, February 6th, at the central electric lighting station, 48, Gloucester Road, Brighton, Messrs. Wheatley Kirk, Price & Goulty will offer for sale by public auction the entire electric lighting plant, instruments, arc lamps, transformers, cable, stores, &c., formerly comprising the property of the Brighton and Hove Electric Light Company, Limited. The sale is to be held on the instruction of the receiver for the debenture holders. The catalogue contains list of a great variety of electrical apparatus which will have to be disposed of.

A New Oil Filter.—Messrs. W. H. Willcox & Co. are introducing an oil filter, of which we give an illustration. They have had this tested in several electric light installations, and have found it to effect a great saving of oil, especially where it is the practice to catch the used oil as its comes from the dynamo bearings. It is also most useful where gas engines are employed, as there is



A. Clean oil chamber or cylinder.
B. Dirty oil chamber or cylinder.
C. Lugs on clean oil cylinder to keep it central.
D. Loose cover of dirty oil chamber.
E. Loose cover of clean oil chamber with perforated rim.
F. Filtering material.
G. Clean oil outlet tube.
H. Dirty oil tap.
I. Filtered oil tap.
J. Back nut joint.
K. Lower grid.
L. Perforated zinc.
M. Upper grid.

acknowledged to be a large amount of waste oil from these engines, and an oil filter is almost absolutely necessary. The construction of the filter is somewhat different to those already known, and will be easily understood from the figure. The dirty oil is put into the outer chamber and filters by gravitation. The filter can be easily cleaned, as it is not necessary to empty it to take away the dirty deposits.

Bankruptcy.—Before Mr. Registrar Cooper last week, at the Liverpool Bankruptcy Court, Loftus John Barnacle, trading as A. Hall & Co., electrical engineers, &c., South John Street, Liverpool, appeared on his public examination with a statement of affairs showing liabilities £496 and assets £524, consisting mainly of 1,040 shares of £1 each fully paid in the Hall Electrical Company, Limited, which he valued at 10s. per share. The preferential claims amount to £25 6s. 8d. and there was an apparent surplus of £2 19s. 7d. The Official Receiver conducted the examination, and Mr. Edwards (Messrs. Bateson & Co.) appeared for the petitioning creditors (the Electrical Company, of London), and Mr. J. W. Wall for creditors. The Bankrupt, who said he was 22 years of age, stated that his failure was due to a loss on a contract with Mr. L. Connolly for the electric lighting of the New Brighton Palace, bad trade generally, and competition. Mr. Wall and Mr. Edwards having asked some questions, the examination was adjourned to February 14th, and the bankrupt was ordered to file a cash account and to write up the cash book.

Change of Firm.—The Electrical Engineering Depôt, until lately carried on at Minories, Birmingham, as a midland branch of Messrs. Woodhouse & Rawson United, Limited, has been purchased by Mr. S. Jevons—under whose management the business was established some three years ago, and has since steadily progressed to its present position. The business will be continued by him in the same premises under the style of S. Jevons, successor to Woodhouse

and Rawson United, Limited. Mr. S. Jevons will retain and expand the principal feature of the business as a depôt for electrical supplies of every description for contractors and the trade generally. He will also still act as midland agent for the Woodhouse & Rawson switches, and other approved specialities. As this change dates back by agreement to October 11th, 1894, all accounts due to and liabilities of the late *midland branch* of Woodhouse & Rawson, *since that date*, will be received and paid by S. Jevons.

Electric Construction Corporation.—In the Chancery Division, on Saturday last, Mr. Justice Romer dealt with a summons on behalf of Mr. Henry Percy Hope asking to have his name removed from the list of the members of the Electric Construction Corporation, Limited, and the list of contributories in respect of 44 preference shares in the company. The applicant's case was in the first place that he never made any application for the shares. That was not disputed, but a Mr. Courtney said there was a tacit understanding amongst the directors, of whom Mr. Hope was one, that they would take a certain proportion of preference shares. The understanding in this particular case appeared to be that at a meeting of the Board at which Mr. Hope was not present, the chairman said he supposed every director would take a fair proportion of shares. No director said he would not, and that was what was relied on as the tacit understanding that Mr. Hope, who was not there, would do so. The second point was that it was suggested that a letter of allotment was sent to Mr. Hope and that he did not return it. It was doubtful if such a letter was sent, and certainly Mr. Hope never received it. And further, though there had been several calls made in 1892, no notice was sent to Mr. Hope and he never paid any of them, or knew that his name was on the register until after the winding up in 1893, when the liquidator wrote to him. These facts were not disputed by Mr. Theobald, who appeared for the company, and his lordship thereupon directed that the register be rectified by the removal of Mr. Hope's name, and ordered the liquidator to pay the costs.

Electric Firm Alarms.—The tender of the Private Wire and Telephone Installation Company, for supplying telephonic and electric fire alarm apparatus for the extensive fire alarm system undertaken by the Tottenham new Urban District Council, has been accepted. The installation will comprise street fire alarms, member's calls, and telephonic communication with the officials of the brigade.

Gas v. Electric Light.—A correspondent of a Bristol paper has had some figures placed in his possession by a professional man who uses the electric light in his offices. The figures are interesting. In 1894 this gentleman had more burners and far more light than when he used gas, yet the cost is less. It is not stated whether current was taken from the public mains, or from a private installation:—

	1892. Gas. £ s. d	1893. Gas and electric light. £ s. d.	1894. Electric light. £ s. d.
Lady-day ...	6 4 4	6 14 6	6 14 8
Midsummer ...	1 7 8	0 19 4	1 7 2
Michaelmas ...	1 14 10	0 15 0	0 17 8
Christmas ...	4 19 5	4 18 6	4 19 1
	£14 6 3	£13 7 4	£13 18 7

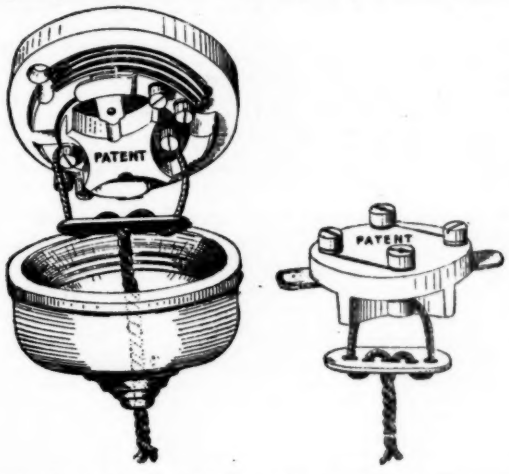
Glasgow Tramways.—At a meeting of the Tramway Committee of Glasgow Town Council, last week, an offer was submitted by a private firm offering to work several of the lines by electricity. It was agreed, without discussion, to decline the offer.

Insulation Test.—Mr. Thomas Barton, of Blackburn, writes us as follows:—"The following insulation test may be of interest to you seeing that the system adopted at Blackburn is the same as that adopted at Nelson, put down by me in 1893, and which has proved so free of faults, viz., a three-wire system consisting of cables continuously insulated with vulcanised rubber, and supported on vitrified stoneware bridges fixed within a cast-iron conduit kept water-tight by means of steel junction pieces (registered No. 243,822). Tests of feeders, ring main and pilot wires at Blackburn. . . . . The total length of cable laid is 6·75 miles. The insulation resistance, including pilot wires is 190 megohms. The tests of the separate cables are as follows, after two minutes electrification: + cable, 1,620 megohms per statute mile; middle cable, 1,530 megohms per statute mile; − cable, 1,580 megohms per statute mile. The specification issued by me was for 800 megohms per statute mile, this result is, therefore, highly satisfactory, being nearly double the guarantee. The cables are of Messrs. Siemens Bros. & Co.'s manufacture."

Laxton's Builders' Price Book.—The new edition of this annual contains, in addition to the usual matter, which has been completely revised up to date, the London Building Act, 1894, which, of itself, occupies 80 pages, closely printed, and forms a section of great value for reference to architects, builders, engineers, contractors, property owners, and many others.

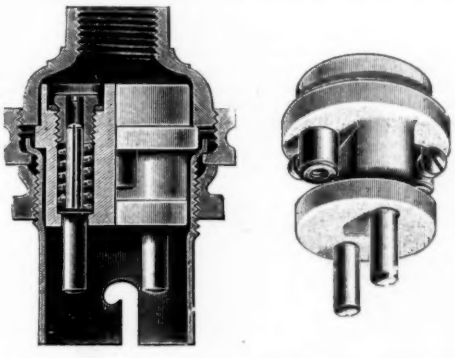
New Agency.—Mr. August Reichwald, of Dashwood House, New Broad Street, informs us that he now represents an important Continental firm of glass makers, who manufacture glass boxes for accumulators, large quantities of which have been supplied repeatedly to consumers in this country.

New Ceiling Rose.—Messrs. Cutting Bros. & Co., of Derby, are placing upon the market a new ceiling rose with detachable double pole fuse, as shown in the illustrations. The makers claim for it that it affords very high insulation; that by using it, labour in fixing is greatly diminished, the major part of the work being done before attaching to ceiling; that pendants connected with it can be taken down in a moment, and replaced by the most inexperienced person. The movable part is thoroughly enclosed, and as there is no *external* metal work, it fully covers the requirements of the principal fire offices. It is specially adapted for shop window



illumination, or for other positions where lamps require frequent removal. It is provided with patent adjustable cord grip, and will sustain any weight to the breaking of the cord without in the least disturbing the electrical connections.

New Lampholder.—Messrs. B. Verity & Sons, of London and Birmingham, have recently patented an improved form of lampholder possessing many good qualities. As will be seen from the two views which we give herewith, the insulation is very satisfactory, the parts being perfectly enclosed in a single piece of china, and nothing being exposed but the two contact plungers. The form of connection for wiring is that known as the "block terminal," and is one of the most popular with the trade. It is claimed that the main advantage in the lampholder seems to lie in the novel form of arrangement of the plungers, and the way in which the current is



carried to the lamp. In most lampholders the current is carried through the spring, but in this the plungers are very long, thus giving great elasticity to the spring, and are split at the lower end, where they pass through the metal plug pieces on the lower face of the china; this ensures a good contact with the said metal parts, and at the same time gives a second bearing, so that it is impossible for the plungers to get out of the perpendicular. It will be seen also that the china itself forms the guides or cylinders for the plungers, so that the insulation is most perfect.

Personal.—The Electrical Company, Limited, have secured the services of Mr. J. Stottner, one of the engineers from the Allgemeine Elektricitats-Gesellschaft, who represented that firm at the Chicago Exhibition. Mr. Stottner will manage the transmission of power department.

Priestman Brothers, Limited.—At the suit of a debenture holder, Mr. Justice North, last Friday, appointed Mr. Watson and Mr. Hodson receivers and managers of the business of this company, which is that of ironfounders and mechanical engineers at Hull.—Counsel stated that the debenture issues were £40,000 first, and £20,000 second, and that the plaintiff held £500.

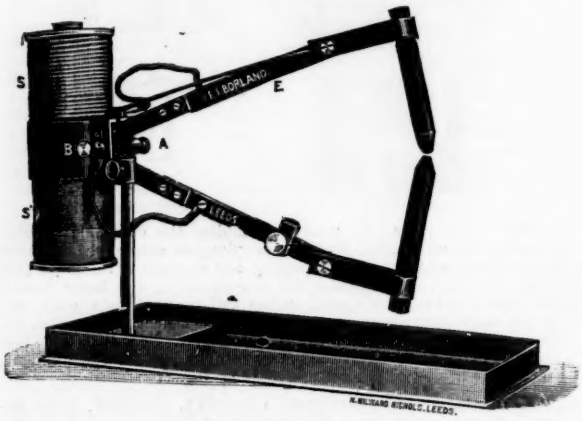
Printing Telegraph Machines at Scotland Yard.—An important innovation has just been made by the officials at Scotland Yard in connection with the communication between the chief officers of each division and the Yard itself. Up to the end of last year and the early days of this year, they worked the tape machines of the Exchange Telegraph Company. These have now been replaced by the instruments of the Column Printing Syndicate, instruments which, while accomplishing automatically the same result, print in column form, and it is claimed that besides being much quicker they are much more reliable. This innovation was not brought about without a severe and prolonged trial, the Exchange Telegraph Company having also a machine printing in column form, which was put into competition with the Column Printing Syndicate's.

The result, as already indicated, was that the police officials and engineers unanimously decided in favour of having the machines of the Column Printing Syndicate. The great advantage of this syndicate's system is that it can work any number of lines off the one set of batteries without the aid of relays, which in all other systems have proved so very troublesome. As all the working parts are moved by the mechanism of a weight, there is necessarily less current required and less for it to do. The system at Scotland Yard has been fitted up through the Post Office, who have put up a lever switch which somewhat resembles a signal-box, thus making the switching arrangement very simple, which is necessary when so many men have to work the system. Scotland Yard can now deliver instantaneously a printed message to any single superintendent, or to any number of them to whom the particular message applies.

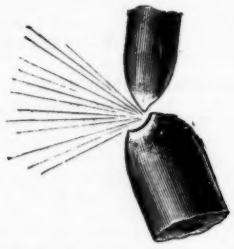
Drake & Gorham.—During last year this firm carried out contracts for electric lighting for a number of well-known bodies and persons including the lighting of Chatsworth Hall for the Duke of Devonshire. Among the others for whom they have executed work are: Lord Houghton, Lord Gosford, Earl Derby, Marquis of Londonderry, Baron William Schroder, Baron de Knoop, Sir Frank Lockwood, Duchess of Montrose, Lady Wynne, Lady Sitwell, Sir Gervas Glyn, Rt. Hon. C. T. Ritchie, Sir Vincent Barrington. Also the Army and Navy Stores, Scarborough Corporation, the Royal Geographical Society, University Galleries, St. George's Hospital (extensions), Balliol College, *The Morning* offices, City of London College. The Manchester and Scarborough branches have also carried out a large number of wiring and other contracts. The total number of lights put in during the year equals over 40,000 of 8 C.P. The D.P. battery introduced some six years ago is steadily gaining in popularity. Spring contact switches command a large sale in the trade and most of the important manufacturers have taken a license for this type of switch. The earthing device has been supplied in large quantities to supply companies. There are now over 2,400 of these in daily use. The Cardew voltmeter has been re-modelled by Major Holden.

Small Engines.—Messrs. W. J. Wells & Co., of Toovies, Worth, Crawley, Sussex, are making a speciality of small steam engines from ¼th to 1 H.P., suitable for driving dynamos supplying from 2 to 24 8-C.P. lamps. The same firm are agents for the Capitaine oil engine. They have just brought out a new catalogue.

The "Dot" Arc Lamp.—The lamp now illustrated is very simple and compact (its weight being under 3 lbs.), which renders it very serviceable for carrying about. It is actuated by direct and alternating currents, and is composed of a series and shunt solenoid lying in the same vertical axis, in the centre of which works a core. Two levers are mounted in the space between the two coils which gear into each other, and open and close simultaneously by the action of the core which is connected to the lower one. The method of working is as follows:—The current enters the upper solenoid by the terminal seen on the right of the illustration, attracts the core which is connected to the lower lever, and the arc is struck. As the



current in the solenoid diminishes, the arc lengthens and increases the current in the lower solenoid which lowers the core. The joint action of the two solenoids thus causes the carbons to approach. Thus the lamp is, in fact, an actual balance, which at all times causes the carbons to approach or separate. It is stated that the working of the lamp is constant and not intermittent, as in lamps provided with mechanism for striking and feeding the arc. A suitable resistance must be provided according to the voltage of the circuit on which the lamp is intended to work, and the two terminals connected up to the mains through the resistance by means of flexible wires. Then, the switch being off, the carbons are inserted in the holders, and upon this setting depends the efficiency of the light obtained. In an ordinary arc lamp where both carbons are in the same axis and vertical, the light is radiated in all directions, and it is important in a lantern lamp that all the rays of light should be radiated in one direction, and that through the condenser. To gain these ends the carbons in this lamp can be fixed at any angle, and in any position during the working. Our second illustration shows the most effective position. The upper or position carbon is set about one-eighth of an inch behind the lower one and at an angle of 20 degrees. In this position it is found that the crater-like form which the positive carbon assumes, reflects all the rays in one direction. The lamp is made for any candle-power from 200 to 2,000, and claims to give double the illuminating power at half the cost of the oxyhydrogen light under ordinary conditions. Mr. F. J. Borland, of 2, Sheepscar Grove, Leeds, the manufacturer, also supplies a heavier type specially



adapted for limelight effects at from 1,000 to 10,000 C.P., the lighter lamps being adapted to lanterns, and the system is useful wherever a solid beam of light is required in any particular direction. Mr. Borland is also the maker of a new form of improved photographic apparatus known as the "Umbrella" pattern.

Mr. Francis G. Baily, lecturer in electro-technics, University College, Liverpool, has tested this lamp, which is made by Mr. F. J. Borland, of Leeds. The lamp was supplied with current from a battery of accumulators at 110 volts, and the current was regulated by the insertion of resistances in the circuit. Mr. Baily reports that the illuminating power of the lamp was maintained with great constancy, and entire absence of flickering, and the regulation was most perfect at 8 ampères. The instantaneous production of a steady light, when the current is turned on, is a marked feature of this lamp, and renders it specially suited for lantern use. The focussing power is good, and the initial adjustment is simple. We place no value on such a test; any lamp will act well with a steadying resistance in circuit with it, such as that used by Mr. Baily.

Spence-Doulton Bare Copper Mains.—In this system of underground electric light mains, Messrs. Doulton & Co. have successfully attempted to combine the advantages of a genuine "drawing-in" system, with those obtainable from bare copper strip mains in culverts. In its design the following objective points have throughout been kept in view:—The maintenance of a high and invariable degree of insulation resistance. Facility for drawing in copper at surface boxes, and for making future additions to the section of copper. The provision of ready means of access, at any point, to the conductors for house connections. Adherence to the most simple forms as the safest means of ensuring permanence to the structure, and entire avoidance of depreciation, together with moderate first cost. Fig. 1 shows the system in earthenware culvert,

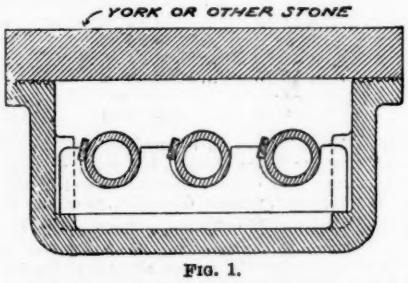


FIG. 1.

and fig. 2 shows it in concrete culvert. The conduit consists of one or more lines of tubes of vitrified stoneware, supported on insulating bridges of the same material (which serve to hold the tubes in place with an air insulation), in a culvert or trough of earthenware, con-

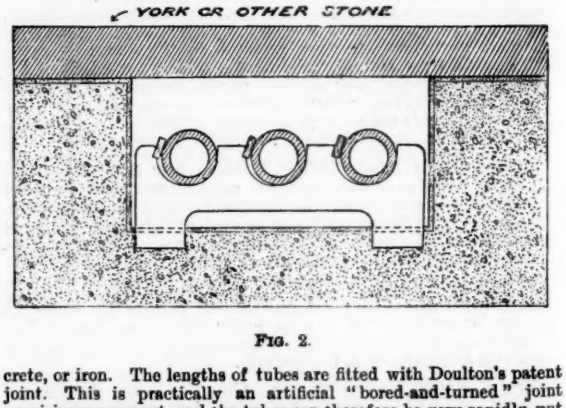
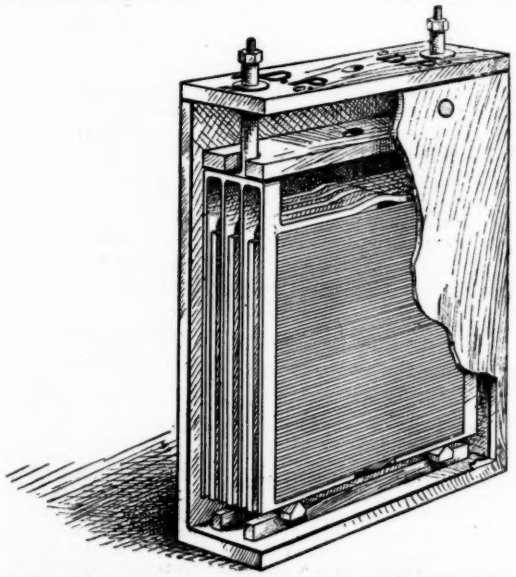


FIG. 2.

crete, or iron. The lengths of tubes are fitted with Doulton's patent joint. This is practically an artificial "bored-and-turned" joint requiring no cement, and the tubes can therefore be very rapidly put into position. Earthenware troughs can be supplied for the culvert, in 2 feet lengths, with socket joints for Portland cement and provided with internal lugs for supporting the bridge insulators in position. This culvert can be more rapidly and conveniently constructed than one of concrete, and the non-conducting character of

the material must also be regarded as an advantage. The tubes are composed of thoroughly insulating material, viz., vitrified enamelled stoneware (which is quite impervious to moisture), moulded into sections suited to the various requirements, but forming in every case a continuous envelope around the conductor. The separate sections or pipe lengths being united end to end by a water-tight joint, surface leakage is entirely prevented, and the danger of breakdown through flooding of the culvert completely obviated. In addition to the insulation given by the tubes (which must at all times be very high, since leakage can occur only through the body of the material), the bridges form a further safeguard in this respect, and the makers claim that as a consequence the insulation resistance is high to start with, and it does not vary. The Spence-Doulton system permits of additional strips being laid down with a facility even greater than that of drawing insulated cables into cast-iron pipes. Existing conductors do not need to be hauled out before new ones can be drawn in, and there being no insulation coating to be abraded, or to weight the strip, the surface boxes may be further apart than is the case where insulated cables are used. In the Spence-Doulton system no straining devices of any kind are used. Everything is retained in position by gravity, and no reliance has to be placed on the efficiency of set-screws or other tension apparatus. With regard to maintenance, there can obviously be no depreciation in a conduit composed entirely of imperishable materials.

Storage Batteries.—Encouraged by the great success of the "D.P." battery during the last five years, Messrs. Johnson and Phillips (the sole makers) are now bringing out a train-lighting adaptation of it. The new cell is shown in the engraving, and its features compared with other well known types are:—Smallness of space occupied; reduced weight; large space between the plates, preventing short-circuiting and collapse of cells; great mechanical

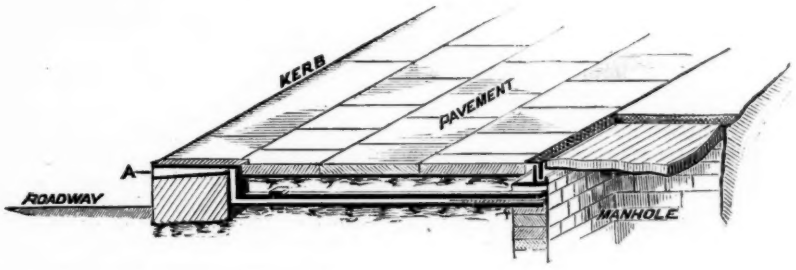


strength and high efficiency. These qualities, coupled with the well known advantages of the battery in point of durability, render it eminently suited for train-lighting work. The particular cell represented is the "B" size, 220 ampère-hours capacity, the outside diminsions being 6½ inches by 10¾ inches by 17¼ inches high, and the weight 92 lbs. These cells are produced by a special electrolytic process, which is entirely free from any patents held by other makers.

Swinburne & Co., Limited.—This firm has opened a show room and offices at 66, Victoria Street (2, Prince's Mansions), S.W., where all inquiries should be addressed.

The Electrical Power Storage Company v. The Chloride Electrical Storage Syndicate.—In the Chancery Division of the High Court of Justice, on Friday, the 18th inst., it was arranged before Mr. Justice North that the trial of this action (a motion in which was reported in our issue of November 30th last), should come before his Lordship on the 5th prox. From our "Notes" columns it will be observed that the contending parties have come to a mutual arrangement.

Ventilation of Street Boxes.—Messrs. Peirson & Co., of Fenchurch Street, are introducing the "Simplex" ventilating system for use in connection with manholes, sewers, coal and other cellars, and all underground works where connected with roadways. The illustration shows the general method of fixing the ventilator tubes, which can be modified as desired to suit any special requirements. The end, A, is provided with guard-bars to prevent the accumulation of rubbish. From the evidence given at the Board of Trade enquiries held before Major Cardew, in November, 1894, and January, 1895, and from other experience, it has been proved that the laying of electricity supply cables throughout the streets in close proximity to gas supply mains and sewer conduits, has made it an imperative necessity to have a thorough system of ventilation applied to the manholes and places of similar construction in connection with any such subterranean works, to avoid the accumulation of gas in the manholes, &c., with consequent danger of explosion. The position in which the "Simplex" ventilating tube is fixed relatively to the cableways, gas or sewer pipes, &c., is claimed to bring about a complete circulation of air in the manhole, and consequently prevents this dangerous accumulation of gas therein. The ventilator pipes are in themselves of the simplest possible construction, strongly made in cast iron, and with the readiest means of cleansing and repairs. The foot pavement requires no special preparation beyond a small chase cut in the top of the kerb-stone, coping, &c. Small inspection and cleaning holes are provided at the end next the kerb, fitted with self-fixing covers. The end into manhole is so constructed



that the channels for outlet of gas and inlet of air are at slightly different levels, and, from actual experiments carried out by the firm, the "Simplex" tube has been found to bring about a complete circulation of air in the chamber to which it may be detached. The approximate cost of fixing the "Simplex" tube to ordinary manholes and inspection boxes, &c., in the streets, including all cutting away and making good to the pavements and manhole walls, is said to be very small. The tube is double channelled, of square section, about 4 inches wide by 1½ inches deep over all, and comprises a Z casting for clearing the kerbstone, and straight tubes to make up to any required length. The joints being loosely socksted, allow for leading off at a slight angle where necessary, and are made up simply with clay or similar easy fixing. The outer portion of the Z casting is given a sharp incline with a small lip just inside to stay the inrush of water on such occasions as street cleaning, &c. Where it is impracticable to ventilate at the curb this outer or Z piece is made to lead away to any desired point, such as up or through a wall, or into a chimney flue, &c., at very slight extra cost. The "Simplex" system may also be applied to the ventilation of dwelling rooms, hospital wards, barracks, workrooms, chemical and such factories, &c.

The Recent Interruptions of the Electric Light at Sheffield.—As there have lately been several irregularities in the supply of electricity the Sheffield Electric Light and Power Company, evidently with a view to preventing any ill feeling on the part of consumers, called a meeting last Monday of their customers at the offices at Sheffield to explain to them the cause of these failures. The Chairman of the meeting was Alderman Franklin, and from his remarks we extract the following:—"The directors had invited the customers of the company to meet them to receive a statement of the causes of the recent failures to supply electric light in some portions of the company's district. The directors felt it was due to themselves, to their shareholders, and to those customers who had pinned their faith in electric lighting, that they should know something of the causes of the recent breakdowns, and also have a satisfactory assurance for the future. They had not met to consider the rights and liabilities of the company in their strict legal aspect, but to explain in a frank and friendly spirit what had led to the very regrettable interruptions in the supply of the electric light. . . . Practically the position was this. Up to last week the company had in use four separate plants of one type capable of illuminating close upon 10,000 lamps continuously and at one time. The causes of failure had mainly been due to electrical weakness in two out of four of these plants. This weakness remained dormant so long as the load was light, but manifested itself under the pressure put upon the plant by what was known to lighting companies as the "Christmas load," although this pressure was well within the margin of power which the machinery was sold to produce. He would probably be asked, 'Why in the world was not the machinery tested to see if it would produce that which it was sold to produce?' It was so tested upon several occasions before the plant was taken over from the contractors, and it was only under actual working conditions that these weaknesses were discovered, and nothing short of practical working would be likely to develop them. Early in the past year the directors, wishing to be well in advance of requirements, placed an order for a large plant of a different type, producing something like 500 H.P., and capable of

illuminating 10,000 candle-power lamps. This machine, which was capable of producing more than the whole of the other four machines, should have been running by the middle of December; the contractors were bound under heavy penalties to have it ready by that time. However, the plant was not ready, and was only able to take the load for the first time last Friday. This machinery was of the strongest and most modern type, and would enable the company to dispense with the weak plant, or have it strengthened, and to give a steady and continuous supply, and even more reliable, he might say, than gas or any other illuminant. They believed that no blame attached either to the company or any officers of the company. The sole responsibility rested upon the contractors who had supplied the plant which under actual working conditions was incapable of continuously yielding the energy for which it was purchased. Of course the directors would now have to reckon with the makers of the plant." Replying to a question as to whether the machinery is in duplicate and whether the company could supply 20,000 lamps, the chairman said: "To-day, yes. We could not at the time of the breakdown. There was," he proceeded, "a good deal of misconception with regard to duplicate machinery. When the output was 8,000 lamps, and the supply was 10,000 lamps, they had not double the machinery, but had a fair margin split up between four machines. Had they had machinery of ten-fold power, it would not have made the slightest difference to the breakdown, owing to the fact that the machines were run in parallel, and that a break on one made a complete breakdown, as the other machinery was not capable of absorbing the whole supply. The old plant they would practically put on the scrap heap. They had now got running one machine which could do all that the other four did, and they had also on order another machine capable of supplying an additional 10,000 lamps." After further discussion the proceedings ended.

Telegraphs in Spain.—It is stated that the Spanish Budget for 1895 includes a sum of £20,000 for improving the telegraphic system of the country, which is at present in a most wretched condition.

The Hartlepools Electric Tramway Scheme.—At a special meeting of the West Hartlepool Town Council last week, the following resolution was adopted:—"That the consent of the Corporation be and is hereby given to the Provisional Order now pending before the Board of Trade, by which it is proposed to authorise the construction of tramways in the borough of West Hartlepool, in the county of Durham, subject to such agreement being entered into between the promoters and the Corporation for the insertion of such clauses and amendments as the Corporation may require."

The Telpherage Company, Limited.—A general meeting of the members of the above company will be held on Tuesday, February 26th, 1895, at one o'clock in the afternoon at the offices of the company, Winchester House, Old Broad Street, E.C., in order that there may be laid before them an account showing the manner in which the winding up has been conducted and the property of the company has been disposed of.

The International Electric Subway Company, Limited.—The creditors of the above-named company are required, on or before February 28th, 1895, to send their names and addresses and particulars of their debts and claims, and the names and addresses of their solicitors (if any) to C. W. Grimwade, of 32, Walbrook, E.C., liquidator of the company, and if so required by notice in writing from the said liquidator are, by their solicitors, to come on and prove their said debts or claims, at such time and place as shall be specified in such notice, or in default thereof they will be excluded from the benefit of any distribution made before such debts are proved.

West Australian Telegraphs.—The Western Australia correspondent of the *Financial News* says that the telegraph line is now being extended to the White Feather, and will be opened shortly. It is also intended to continue the line to Kurnalpi, *viâ* the I.O.U. As soon as the material from England is available, the line will be run from Coolgardie to the 90-Mile.

CONTRACTS OPEN AND CLOSED.

OPEN.

Croydon.—The High Street Special Committee of the Croydon Town Council has been instructed to obtain and accept tenders for wiring and the supply of electric light fittings for the Town Hall.

Lisbon.—January 31st. Tenders are invited for telegraphic apparatus and porous jars required by the Royal Portuguese Railway Company, of Lisbon. Particulars are obtainable from the bureau of the Compagnie Royale des Chemins de Fer Portugais, 28, Rue de Châteaudun, Paris.

Moss Side.—February 6th. The School Board invite tenders for the installation of the electric light in their schools in Princess Road, Moss Side. Plans may be seen, and specifications and bills of quantities, with forms of tender, obtained from Mr. S. V. Clirehugh, M.I.C.E., Temple Chambers, Brazennose Street, Manchester, consulting engineer, on and after Monday, the 28th inst.

Roumania.—February 1st. Tenders are being invited until February 1st by the Roumanian Post and Telegraph authorities in Bucharest for the supply of a quantity of telegraph posts of different lengths.

Spain.—February 8th. Tenders are being invited by the municipal authorities of Guipuzcoa (Irun) for the establishment of a central station for the electric lighting of the town. The plant is to comprise two 70 H.P. engines, two dynamos (one giving 300 ampères at 125 volts, and one giving 180 ampères at 170 volts, and a battery of 62 accumulators.

Sweden.—January 30th. The Swedish Telegraph Department in Stockholm is inviting tenders for the supply of 175,000 porcelain insulators, 125,000 telephone hooks, 365 tons of iron wire, and 63 tons of bronze wire.

CLOSED.

Coventry.—The tender of Messrs. Chamberlain and Hookham has been accepted for the supply of electricity meters to the City Council. Each meter has to be certified as efficient by the Electrical Standardising and Testing Institution, the specification having been prepared by Mr. Robert Hammond, the Council's consulting engineer. The following were the tenders sent in for the meters:—

Chamberlain & Hookham, Limited, Birmingham ...	£270	10	0
Westinghouse Electric Company, London	295	17	9
Electric Construction Co., Limited, Wolverhampton	299	4	0
General Electric Company, Limited, London ...	336	7	6
British Thomson-Houston Co., Limited, London ...	406	5	4
Charles A. Miller, Bradford	462	0	0

The extra charge for certificate of efficiency is 6s. per meter, which will bring the total of Messrs. Chamberlain's tender up to £291 4s.

CITY NOTES.

The Industrial Inventions Development Co., Limited.

THIS company invite applications from shareholders and creditors of Woodhouse & Rawson United, Limited, for 7,000 shares of £1 each, of which 1,000 have been applied for by the directors. The company will acquire or obtain rights under certain letters patent, of which the principal are obtained from the receiver of Woodhouse & Rawson, United. They relate to "electric metal pickling," "smooth running wheels," "temporarily hardening mantles" for incandescent gas burners, "zinc recovery," "electric renovating" of rusty scrap, &c. It is not intended to confine the operations of the company to working the above patents. They purpose continuing the business of developing and placing the patents of inventors, as previously carried on by Woodhouse & Rawson, United, which department "it is believed has been always well and carefully managed" under Mr. F. L. Rawson. Accompanying the prospectus is a circular from Mr. F. L. Rawson, intimating that he had come to the conclusion that in the patents specified there existed a source of large future profits, "and that by their means the shareholders and creditors might in time recover a considerable part of their losses."

It is a little difficult to reconcile the statement as to losses, with the "well and carefully-managed," and it seems to us that shareholders and creditors of Woodhouse & Rawson, United, should carefully consider that point before applying for shares. As to the processes for which patents are acquired, we are strongly of opinion that they need developing and proving in the actual trades concerned before being submitted to the notice of the general investor.

The City and South London Railway.

JUST as we go to press we have received the directors' report for the half-year ending December 31st, 1894. It states that the receipts from all sources for the past half-year have amounted to £24,252, and the cost of working has been £14,762, leaving a profit of £9,490. We have already announced the dividend of the company, which was 5 per cent. per annum on the preference shares and a dividend of 1¼ per cent. on the ordinary stock. The number of passengers for the half-year ending December 31st was 3,275,649, and the receipts £23,340, against 3,093,351 passengers and £22,067 for the corresponding six months of the previous year. The report records a steady growth of the traffic during all hours. It is satisfactory to learn that the experiments have resulted in a new motor car train, which will lead to the gradual abandonment of the separate locomotive.

Eastern Telegraph Company, Limited.

THE directors, in their report for the six months ended September 30th last, state that the revenue for the period amounted to £362,557, from which are deducted £97,533 for the ordinary expenses and £43,709 for expenditure relating to repairs and renewals of cables, &c., during the half-year. After providing £4,815 for depreciation of spare cable, £1,138 due to revaluation of currency assets, and £5,458 for income-tax, there remains a balance of £209,902, to which is added £2,001 brought from the preceding half-year, making a total available balance of £211,903. From this balance there have been paid interest on debentures and debenture stock, dividend on preference shares, and two interim dividends of 2s. 6d. per share each on the ordinary shares. After carrying £4,860 to the reserve fund for maintenance of ships, there remains a balance of £59,175, which is carried forward to the next account. The revenue includes £22,687 dividends for the

half-year upon the company's shares in the Eastern and South African, the Black Sea, the Direct Spanish, and the African Direct Telegraph Companies.

At the meeting held yesterday, Sir John Pender presided, and, in the course of his speech, went into the various items of increase and decrease in the receipts compared with the previous period. Nothing very definite had occurred during the six months, but there had been a considerable amount of work done. Being of opinion that an improvement might be effected in the speed and accuracy of the transmission of telegrams, they had as many as possible of their principal superintendents in London to confer together and give the company the benefit of their practical experience in that way before effecting any important alterations. He believed this conference had resulted in the increase that had occurred in the receipts. The company's share in connection with the twenty-fifth anniversary, held at the Imperial Institute, was £836, and the dinner to the company's own foreign staff £790. Expenses attending cable repairs, &c., was £43,709, against £31,906 last year. Although the amount carried forward this half-year is considerably less than in the corresponding period, they had recouped the decrease shown at September, 1894, and for the nine months to December 31st, they showed a larger total than in the corresponding period of 1893. If the traffic receipts continued as good for the next few months, they would show a very fair result at the end of the financial year. They had been passing through harder times than had been experienced for many, many years, not only in this country, but hard times at every point where their lines touched; and considering this, their position was very satisfactory. During the six months there had not been any complaints from customers. He dare hardly hope to live to see the golden wedding of the submarine telegraph, but if they maintained the efficiency of the lines, progress would continue during the next 25 years, and great things would be done. Sir John said he had just been negotiating for an extension of their subsidy with Cape Colony. There were yet five years unexpired, but they were hopeful of getting a 10 years' further subsidy under revised conditions.

After further comments, the Marquis of TWEEDALE seconded the adoption of the report, which was carried.

Retiring directors and auditors were re-elected, and a cordial vote of thanks to the chairman and directors closed the meeting.

Anglo-American Telegraph Company, Limited.

THE directors' report, to be presented to the ordinary general half-yearly meeting at Winchester House to-day (Friday), January 25th, 1895, at 2 o'clock p.m., states that the total receipts from July 1st to December 31st, 1894, including the balance of £1,173 8s. 5d. brought forward from the last account, amounted to £148,837 4s. 7d. This sum, however, is subject to revision, as the financial result of the judgment given in favour of this company against the Paris and New York Telegraph Company cannot yet be determined. The traffic receipts show a decrease of £6,948, as compared with the corresponding period of last year. The total expenses of the half-year, including the repair of cables, &c., as shown by the revenue account, amounted to £55,851 18s. 5d., being a decrease of £3,399 0s. 10d. The directors, under the powers conferred upon them by the articles of association, have, before declaring the net profits, set apart the sum of £12,000 to the renewal fund, leaving a balance of £80,985 6s. 2d. Interim quarterly dividends of 9s. per cent. on the ordinary stock, and 18s. per cent. on the preferred stock, were paid on November 1st last, absorbing £31,500, leaving a balance of £49,485 6s. 2d., out of which the directors recommend the proprietors to declare final dividends of 14s. per cent. on the ordinary stock, and £1 8s. per cent. on the preferred stock, amounting to £49,000, making a total distribution for the year ended December 31st, 1894, of £2 2s. per cent. on the ordinary stock, and £4 4s. per cent. on the preferred stock, leaving £485 6s. 2d. to be carried forward to the next account. The company's repairing ss. *Minia* has been engaged during the past half-year in the repair of the "Northern" and "Southern" Placentia, the "Tricore," "Rantem," and "Duxbury" cables. She has also been employed by the Direct United States Cable Company, and the Western Union Telegraph Company, for the repair of cables belonging to those companies, the payments for which appear in the revenue account. In accordance with the articles of association, two directors of the company, the Most Hon. the Marquis of Tweeddale and Charles Burt, Esq., retire at this meeting, and, being eligible, offer themselves for re-election. Mr. Joshua Dean and Mr. John Gane, F.C.A., the auditors, retire, and offer themselves for re-election.

The Direct United States Cable Company, Limited.

THE directors' report for the six months ended December 31st, 1894, to be presented at the meeting of the company, to be held at Winchester House to-day, at 1 o'clock p.m., states that the half-year's revenue, after deducting out-payments, amounted to £38,342 8s. 4d., as compared with £41,051 19s. 11d. for the corresponding period of 1893, being a difference of £2,709 11s. 7d. against the half-year under review. The working and other expenses for the same period, including income-tax, but exclusive of cost of repairs of cable, amounted to £19,024 6s. 3d., leaving a balance of £19,318 2s. 1d. as the net profit, making with £1,031 17s. 2d. brought forward from the previous half-year a total of £20,349 19s. 3d. For the corresponding period of 1893, the working expenses and other payments amounted to £19,059 16s. 5d. Interim dividends of 2s. per share for the quarter ended September 30th, 1894 (paid October 24th, 1894), and of 2s. per share for the quarter ended December 31st, 1894 (payable January 26th, 1895), together amounting to £12,142, have been declared, and after setting aside £3,400 pending settlement of disputed accounts with other telegraph companies, and £3,000 to the reserve fund account, the balance of £1,807 19s. 3d. on the revenue account has been carried forward. During the period under review, repairs have had to be made of the company's short section of cable at a cost of £1,611 18s. 2d., which has been debited to the reserve fund account as heretofore, the balance of which, with the addition of interest, profit, and the amount set aside from revenue account, now amounts to £288,905 2s. 1d. The directors record with deep regret the death of their esteemed colleague, Mr. Charles Meara, which occurred at Antwerp on November 16th last. It is not intended at present to fill up the casual vacancy thus occasioned in the board.

The Edison & Swan United Electric Light Company, Limited.

THE shares in this company, which were issued in 1883 to the Swan United Electric Light Company, Limited, and which have been held by the directors of that company *en bloc* as trustees for the company, having now, by reason of the liquidation of the Swan United Company, been distributed to the shareholders of that company, the directors have resolved to make an application to the committee of the Stock Exchange for a quotation for this company's shares and debenture stock. In order to bring the articles of association of this company into conformity with the present rules of the Stock Exchange, it is necessary to make some alterations in the articles, and for that purpose a general meeting of the shareholders is being called for Tuesday, February 5th, 1895, at 12.30. The following are full particulars of the proposed alterations. The meeting will consider and, if approved, pass the following resolutions, which, if passed, will be submitted to a subsequent general meeting for confirmation as special resolutions:—That Article 10 be repealed, and the following article substituted:—"10. The instrument of transfer of any share in the company shall be on the usual common form, under seal, and be executed both by the transferor and transferee, and the transferor shall be deemed to remain the holder of such share until the name of the transferee is entered in the register book in respect thereof."

That the words "or stock" be omitted from Article 11.

That the following words be inserted at the end of Article 16:—"And that no call shall exceed one-fourth the nominal amount of a share, nor be made payable within two months after the last preceding call was payable."

That in Article 20 the words "not fully paid up" be inserted after the word "shares."

That Article 41 be repealed, and the following article substituted therefor:—"41. Seven days' notice of any general meeting (exclusive both of the day on which the notice is served or deemed to be served, and of the day of the meeting) specifying the day, hour and place of the meeting shall be given to the members in manner hereinafter mentioned, or in such other manner as may from time to time be prescribed by the company in general meeting; but the non-receipt of such notice by any member shall not invalidate the proceedings at any general meeting.

"41A. The notice convening an ordinary general meeting shall state the general nature of any business intended to be transacted thereat, other than declaring dividends, electing directors and auditors, and voting their remuneration and considering the accounts presented by the board, and the reports of the board and the auditors. The notice convening an extraordinary general meeting shall state the general nature of the business intended to be transacted thereat."

That Article 59 be repealed, and the following article substituted:—"The qualification of a director shall be the holding, in his own right, of not less than 200 'A' or 'B' shares. A first director may act before acquiring his qualification, but shall, in any case, acquire the same within one month from his appointment, and unless he shall do so he shall be deemed to have agreed to take the said shares from the company, and the same shall be forthwith allotted to him accordingly."

That in Article 65, Clause (*c*), the words, "or in loans upon the security of" be inserted before the words "its own shares."

That the following words be inserted at the end of Clause (*f*) of the same article:—"Provided that without the sanction of a general meeting the board shall not raise or borrow any sum of money which will make the amount raised or borrowed and then outstanding exceed £200,000."

That the following words be added at the end of Article 94:—"And a copy of such balance-sheet and account shall be sent seven days before the general meeting to each member entitled to the same."

By order,
H. CHARLES GOVER, *Secretary*.

Dated *January 17th*, 1895.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending January 20th, 1895, amounted to £996; week ending January 21st, 1894, £947; increase, £49; total receipts for half-year, 1895, £3,001; corresponding period, 1894, £2,888; increase, £113.

The Liverpool Overhead Railway Company. The traffic receipts for the week ending January 20th, 1895, amounted to £900; corresponding week last year, £636.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending January 18th, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company Limited, were £3,670.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1892.	1893.	1894.	Closing Quotation, January 16th.	Closing Quotation January 23rd.	Business done during week ended January 23rd, 1895. Highest.	Lowest
173,400£	African Direct Teleg., Ltd., 4 % Deb.	100	...	...	...	101 —104	101 —104	...	...
1,012,880£	Anglo-American Teleg., Ltd.	Stock	£2 15s.	£2 11s.	...	41½— 42½	41 — 42	41½	...
2,993,560£	Do. do. 6 % Pref.	Stock	£5 10s.	£5 2s.	...	77½— 78½	77 — 78	78	77¼
2,993,560£	Do. do. Defd.	Stock	...	...	...	6⅝— 7¼	6½— 7	...	...
130,000	Brazilian Submarine Teleg., Ltd.	10	6½% §	6½% §	...	11¼— 11¾	11½— 11⅝	11⅝	11 7/16
75,000£	Do. do. 5 %, repayable June 1906	100	...	...	...	109 —113	109 —113	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 40,000	5	10%‖ §	... §	...	2 — 3	2 — 3	...	...
10,000,000$	Commercial Cable Co.	$100	7 %	7 %	...	140 —150	147 —152	...	...
224,850	Consolidated Telep. Const. and Main., Ltd.	10/-	2 % §	2 % §	...	1/16— 3/16	1/16— 3/16	...	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	...	13 — 14	13 — 14	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	...	19½— 20½	19½— 20½	...	...
12,931	Direct Spanish Teleg., Ltd., £4 paid	5	4 %	4 %	...	4 — 4½	4 — 4½	...	...
6,000	Do. do. 10 % Pref.	5	10 %	10 %	...	9½— 10	9½— 10	...	...
30,000£	Do. do. 4½ % Debs of £50, Nos. 1 to 1,600	...	...	...	...	103 —106%	103 —106%	...	...
60,710	Direct United States Cable, Ltd., 1877	20	3½% §	2⅝% §	...	8½— 9 xd	8½— 9 xd	9	8⅞
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6½% §	6½% §	...	16⅛— 16⅜xd	16⅛— 16⅜xd	16⅜	16 5/16
70,000	Do. 6 % Pref.	10	6 % §	6 % §	...	17 — 17¼xd	17 — 17¼xd	17⅜	17⅛
102,100£	Do. 5 % Debs., repay. August, 1899	100	...	...	...	106 —110	106 —110	...	...
1,297,837£	Do. 4 % Mort. Deb.	Stock	...	...	...	121 —124	122 —125	...	...
250,000	Eastern Extension, Australasia and China Teleg., Ltd. ...	10	7 %	7 %	...	16⅜— 16⅝xd	16⅜— 16⅝xd	16⅝	16½
54,100£	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	...	...	...	102 —106	102 —106	...	...
194,300£	Do. do. Bearer, 1,050—3,975 and 4,327—6,400	100	...	...	...	103 —106	103 —106	...	...
320,000£	Do. 4 % Deb. Stock	Stock	...	...	...	122 —125	123 —126	124⅜	...
95,100£	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	100	...	...	...	102 —106	102 —106	104¾	...
129,100£	Do. do. do. to bearer, 2,344 to 5,500	...	...	...	...	103 —106	103 —106	...	...
300,000£	Do. 4 % Mort. Debs. Nos. 1 to 2,016, red. 1909	100	...	...	...	106 —109	106 —109	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	...	...	...	111 —114%	111 —114%	...	...
180,227	Globe Telegraph and Trust, Ltd.	10	4⅜% §	4⅜% §	...	8⅞— 9⅛xd	9 — 9⅛xd	9⅛	9
180,042	Do. do. 6 % Pref.	10	6 % §	6 % §	...	16½— 16⅝xd	16½— 16⅝xd	16⅝	16 3/16
150,000	Great Northern Teleg. Company of Copenhagen	10	8⅖% §	8⅖%	...	21¾— 22¼	21¾— 22½	...	...
190,000£	Do. do. do. 5 % Debs.	100	...	...	...	105 —108	105 —108	...	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10 %	...	48 — 50	50 — 52	51½	50½
37,548	London Platino-Brazilian Teleg., Ltd.	10	...	...	...	5 — 7	5 — 7	...	...
100,000£	Do. do. 6 % Debs.	100	...	...	...	103 —107	105 —109	108½	...
15,000	Monte Video Teleph. Co., Ord., 1 to 15,000	5	...	...	...	½— ⅝	½— ⅝	...	...
28,000	Do. do. 6 % Pref., 1 to 28,000	5	...	...	...	1½— 2½	1½— 2½	...	...
484,597	National Teleph., Ltd., 1 to 438,984	5	5 % §	5 % §	...	5¼— 5½	5¼— 5½	5½	5 5/16
15,000	Do. 6 % Cum. 1st Pref.	10	...	...	...	15 — 17	15 — 17	15⅝	...
15,000	Do. 6 % Cum. 2nd Pref.	10	...	...	...	15 — 16	15 — 16	...	...
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 90,950	5	...	...	...	5⅞— 6⅛	5⅞— 6⅛	6⅛	5⅞
1,100,000£	Do. 3½ % Deb. Stock Red.	...	...	...	...	103 — 105	104 —106	105¾	103¾
48,800	New Teleph., Ltd., 25,901 to 74,700; £4 paid	10	...	...	...	... ...	... ...	...	...
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	...	...	...	⅛— ⅜	⅛ — ⅜	...	...
100,000£	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	100	...	...	...	104 —107	104 —107	...	...
11,839	Reuter's Ltd.	8	5 %	0 %	...	2 — 4	2 — 4	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	114 —119	114 —119	118	...
58,000	United River Plate Teleph., Ltd.	5	...	...	...	1 — 2	1 — 2	...	...
146,733£	Do. do. 5 % Debs.	Stock	...	...	...	86 — 91	86 — 91	...	...
15,609	West African Teleg., Ltd., 7,501 to 23,109	10	..	0 %	...	3 — 5	3 — 5	...	...
238,300£	Do. do. do. 5 % Debs.	100	...	...	...	101 —104	101 —104	104½	103½
30,000	West Coast of America Teleg., Ltd.	10	...	...	...	1½— 2½	1½— 2½	...	...
150,003£	Do. do. do. 8 % Debs., repay. 1902	100	...	...	...	97 —102	98 —103	...	...
64,245	Western and Brazilian Teleg., Ltd.	15	2½%	2½%	...	11 — 11½	10⅞— 11⅛	11⅛	10 15/16
33,129	Do. do. do. 5 % Cum. Pref. ...	7½	...	...	...	6¼— 6⅝	6⅛— 6⅜	6⅜	6⅛
33,129	Do. do. do. 5 % Def.	7½	...	...	...	5 — 5⅛	4¾— 5¼	5¼	4 15/16
171,900£	Do. do. do. 6 % Debs. "A," 1910 ...	100	...	...	...	102 —106	103 —107	...	...
214,800£	Do. 6 % Mort. Debs., series "B," red. Feb. 1910	100	...	...	...	102 —106	103 —107	...	...
88,321	West India and Panama Teleg., Ltd.	10	¼%	⅜%	...	1 — 1½	1 — 1½	...	...
34,563	Do. do. do. 6 % 1st Pref. ...	10	...	...	...	10⅜— 11⅛	10⅜— 11⅛	11 1/16	...
4,669	Do. do. do. 6 % 2nd Pref. ...	10	...	..	..	9 — 10	9 — 10	...	...
80,000£	Do. do. 5 % Debs. (1917) No. 1 to 1,000	100	...	...	...	108 —111	108 —111	...	...
$1,211,000	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds ...	$1000	...	...	...	115 —120	115 —120	...	...
166,900£	Do. do. 6 % Ster. Bonds.	100	...	...	...	102 —104	102 —104	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply	5	5 %	4½%	...	4½— 5½	4½— 5½	...	...
40,000	City of London Elec. Lightg. Co., Ltd., Ord. 40,001—80,000	10	...	...	...	14 — 15	14½— 15½	15	...
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	15 — 15½	15¼— 15⅜	15⅝	15¼
100,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	130 —133	132 —135	134	132
50,000	†Liverpool Electric Supply, all paid	5	5 %	5 %	...	7 — 7⅛	7 5/16— 7 7/16	7⅜	7⅛
49,900	*Metropolitan Electric Supply, Ltd., 101 to 50,000 ...	10	2 %	2½%	...	9⅜— 10¼	9⅜— 10¼	10 1/16	...
100,000£	Do. 5% Deb., bonds of £10, £20, £40	...	...	...	...	... — ...	... — ...	...	...
150,000£	Do. 4½% first mortgage debenture stock	...	...	...	...	116 —119	117 —120	117½	117
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	...	...	...	7 — 7½	7 — 7½	7⅜	...
19,980	St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-18,780	5	7½%	4½%	...	8 — 8½	7⅞— 8¼	8⅛	7 15/16
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	...	8⅜— 9¼	8⅜— 9¼	9⅛	9
59,900	*Westminster Electric Supply Corp., Ord., 101 to 60,000 ...	5	3½%	4 %	...	7¼— 7⅝	7½— 8	7⅞	7⅝

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1892.	1893.	1894.	Closing Quotation, Jan. 16th.	Closing Quotation, Jan. 23rd.	Business done during week ended Jan. 23rd, 1895. Highest.	Lowest.
90,000	Brush Elecl. Enging. Co., Ord., 1 to 90,000	3	6 % §	6 % §	...	2⅝ — 2⅞	2⅝ — 2⅞	2 13/16	2 11/16
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	6 % §	6 % §	...	2⅞ — 2⅞	2⅞ — 2⅞	2⅞	2⅞
125,000*l*	Do. do. 4½ % Deb.	Stock	...	...	...	111 —114	111 —114	113½	112½
630,000*l*	City and South London Railway	Stock	⅝%	⅝%	...	44 — 46	44 — 46	45½	45¼
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	5	7 % §	7 % §	...	3 — 3½	3 — 3½	...	...
50,000*l*	Do. do. 5 % 1st Mort. Debs., 1—400 of £100, and "A" 1—200 of £50 each	...	...	...	...	97 —102	102 —107	...	...
120,000	Electric Construction, Ltd., 1 to 120,000	2	...	...	...	¼ — ½	¼ — ½	⅜	...
12,845	Do. do. 7 % Cum. Pref., 1 to 12,845 ...	2	...	...	...	1½ — 2	1½ — 2	...	...
100,000	Elmore's French Patent Cop. Deposg., Ltd., 1 to 66,750 ...	2	*nil*	*nil*	...	1/16 — 3/16	1/16 — 3/16	...	...
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	2	*nil*	*nil*	...	1¼ — 1⅝	1¼ — 1⅜	1¼	...
69,385	Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ...	2	*nil*	*nil*	...	⅝ — 1⅛	⅞ — 1⅛	1⅛	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300	5	*nil* §	*nil* §	...	½ — 1½	½ — 1½	...	...
9,600*l*	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	10	...	...	...	6½ — 7½	6½ — 7½	...	...
6,837	Henley's (W. T.) Telegraph Works, Ltd., Ord.	10	5 %	5 %	...	9 — 10	9 — 10	...	...
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	12½%	12½%	...	25½ — 26½	25½ — 26½	26⅜	26
200,000*l*	Do. do. do. 4½ % Deb., 1896	100	...	...	...	102 —104	102 —104	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	...	1 %	...	8⅞ — 9	8½ — 8⅝	8 7/16	...
6,295	† Do. do. Pref., £8 paid	10	...	...	...	13 — 13¼	13 — 13¼	...	...
	Swan United Electric Light, Ltd.	...	10 % §	7½% §	...	... — ...	... — ...	...	...
37,350	Telegraph Constn. and Maintce., Ltd.	12	15 %	20 %	...	41 — 43	41 — 43	43	42
150,000*l*	Do. do. do. 5 % Bonds, red. 1894	100	...	...	...	104 —107	104 —107	...	...
54,000	Waterloo and City Railway, Nos. 1 to 54,000, £2 paid ...	10	...	...	...	2⅜ — 2⅝	2½ — 2¾	2¾	2 7/16

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 50 % for 1890.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

CROMPTON & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0%; 1891—7%; 1890—8%.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Birmingham Electric Supply Company, Ordinary of £5 (fully paid), 5¼—5⅜.
Electric Construction Corporation, 6 % Debentures, 93—97.
Electric and General Investment, shares of £5 (£1 paid).
House-to-House Company (£5 paid), 2¼—2½.
Do. do. 7 % Preference, of £5, 6½—7.
Do. do. 6 % Debentures of £100, 105—107.
Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid) 7—7¼; 1st Preference Cumulative 6 %, £5 (fully paid), 7—7½.
Liverpool Electric Supply, £5 (fully paid), 6⅜—7.
London Electric Supply Corporation, £5 Ordinary, ¼—½.
Queen Anne's Mansions Lighting and Heating Company, 6 % £100 Debentures, 99—101.
Yorkshire House-to-House Electricity Company, £5 Ordinary Shares (£4 10s. paid), 4¼—4⅜.

Bank rate of discount, 2 per cent. (February 22nd, 1894).

THE CONSUMPTION OF ALTERNATING ARC CARBONS.

IT is well-known that in an arc lamp supplied with the direct current the consumption of the two carbons is unequal, notwithstanding the fact that the same current and the same quantity of electricity pass through both. Although many plausible theories have been put forward to explain this phenomenon, it has practically baffled elucidation. A similar phenomenon is sometimes observed in the alternating arc light, when, as before, the same current and the same quantity pass through both carbons.

In a paper published in the *Transactions of the American Institute of Electrical Engineers*, Vol. ix., p. 370, and in another paper on "Alternating Currents" in the same volume, p. 170, Drs. Bedell and Crehore showed that with an unsymmetrical alternating current, the energy expended during successive semi-periods may not be equal, although in all cases the quantity of electricity which passes is the same. This they suggested at the time "might afford an explanation for the fact that in many cases one carbon of an alternating current arc lamp is consumed more rapidly than the other, depending upon the way it is connected up." Exception having been taken to this suggestion, Drs. Bedell and Crehore have sent the following extended explanation to the *Electrical World*, New York:—

The positive carbon is consumed the faster, and for the purpose of illustration we will assume that the positive is consumed twice as rapidly as the negative carbon. This being the case, consider the alternating arc lamp, with carbons, A and B, supplied with an unsymmetrical alternating current, such that the *energy* in successive semi-periods is not equal, being greater when A is positive. If the frequency is 130 complete periods per second, then one-half of a period lasts $\frac{1}{260}$th of a second. During the first $\frac{1}{260}$th of a second, when A is positive, we may regard the lamp as a direct-current lamp, and suppose that A now loses 6 units of carbon. During the same time B, therefore, loses one-half as much, or 3 units, as in a direct-current lamp. During the next $\frac{1}{260}$th of a second the current reverses and B is now positive. Under the assumption that this semi-period is unsymmetrical with the first, so that the energy is less now than during the first semi-period, of course B will lose less carbon than A did before. Suppose B now loses 4 units. Regarding the lamp as a direct-current lamp during this semi-period, A will lose one-half as much as B, or 2 units. Evidently during the whole period, or during the $\frac{1}{130}$th part of a second, A loses 6 + 2 = 8 units, while B only loses 3 + 4 = 7 units, and so on during every successive period A loses more than B. It therefore follows that this is a possible explanation of the phenomenon, known as the result of experiment, that in many cases the two carbons in an alternating arc lamp are consumed unequally.

This seems to have another bearing, namely on the question of electrolysis by alternating currents. The *Electrical World*, New York, says that if the two carbons of an alternating current arc are consumed at unequal rates as a natural consequence of the form of the current curve being unsymmetrical, the same reason would account for electrolysis under corresponding circumstances. Should the explanation be true, and it certainly seems sufficiently reasonable, it follows that unsymmetrical currents are more dangerous than symmetrical currents.

Our contemporary, still remembering the agitation which has been going on in the American technical press lately on the subject of electrocution, remarks that an application of the above principle might be usefully made by designing alternators for electrocution purposes to generate unsymmetrical currents, thus adding to the effect on the unhappy criminal.

PROCEEDINGS OF SOCIETIES.

Institution of Electrical Engineers.

INAUGURAL ADDRESS, by R. E. CROMPTON, M.Inst.C.E., President.

Delivered at the Ordinary General Meeting, January 10th, 1895.

(*Concluded from page 72.*)

TURNING, now, to the possible extension of the load from the use of motive power, we know how large a portion of the income of the American supply companies has been during the past two years

obtained from its motor load, and that up to the present our motor load in England, at all events in London, has been insignificant. I have attempted to find out, by putting questions to the managers of the most important American electrical supply works, whether the habits of the American people, or the construction of the dwellings in which they live or of their business premises, was such as to cause a special demand for motive power which would never arise on this side. In putting these questions, I fully expected to hear that their large motor load would be chiefly attributed to the driving of elevators, to the ventilating of their rooms during their exceptionally hot summers, and to the working of special machinery necessitated by their lofty buildings; but I am told that this is not so, that many of the large hotels and larger blocks of buildings possess their own separate plant for working their elevators and other machinery, and that the bulk of the motor load of the electric supply stations is obtained from the buildings of a moderate size, and that in these the motors are used for small industries and for domestic work, both of which uses are likely to exist to an equal extent in London or in any large English towns. If this is the case, we may feel sure that the commercial enterprise of those amongst you who make and sell electric motors, and the engineers of our supply companies who are so desirous of increasing their motor load, will be sufficient to make it gradually approximate to the American one. In this connection it is curious to note that, although we, in our central stations, are so anxious to increase the output of our plant, and hence our load factor, by encouraging the use of electric motors, the main argument we must use to an intending user is, that of all sources of motive power, none can be worked with so little waste of power during long periods of idleness as the electric motor. In other words, the electric motor is the cheapest of all systems of driving machinery when the load factor is at its lowest. To mention a very ordinary case. Throughout all residential districts there exist a considerable number of small shops for repairing, and in some cases making domestic furniture on a small scale. In many cases it would be an advantage in such a small shop if one or two machine tools, such as a saw and a moulding machine, could be occasionally used for preparing the material. Such a machine would require from 3 to 5 H.P. to drive it when doing useful work. In most cases these machines would be only used for a few minutes at a time, several times a day, the total use probably not extending to more than seven hours per week. If the user obtained his power from a central source of supply, and paid 4d. per unit for it, the total cost of working these two machines would only be about 7s. per week, although the above time would be made up of many short periods of use. If we add on an ample sum for the interest on the cost of the machines and motors and for their maintenance, the total cost need not exceed £1 per week, so that it is evident that, in many cases, it would pay well to employ such tools and motors, rather than send work out to be executed at a sawmill. It is evident that if the same intermittent employment of power had to be obtained from a steam engine, or even a gas engine, the total cost of full attendance and upkeep would be from £3 to £2 per week, quite apart from the many inconveniences and dangers attending the use of steam power in small premises. It is, evident, however, that as you increase the hours during which these machines are worked, the electric motor will lose its advantages, and a point will be reached at which, first, the gas engine, and eventually the steam engine, will be found to compete favourably as regards cost.

This argument of the cheapness and convenience of the electric motor for very intermittent supply of power is one which cannot be impressed too strongly on likely future users of power; but, apart from what we can do in supplying power to such small industries, there is much to be done in this country in familiarising the minds of the inhabitants of Mayfair and Kensington—to take these districts only as typical of many others—that the use of motive power in private houses need not be limited to working lifts, driving sewing machines, knife cleaners, grinding coffee, or even, as has been stated in another presidential address, "brushing their boots, washing their faces, and serving their meals." With great deference to the gentleman whose words I have just quoted, I must submit that there has hitherto been a certain want of imagination shown whenever the question of the possible extended use of motors has been discussed. No one can help noticing that amongst English women and English men, at any rate, the desire to work at home, to make something useful or artistic, or to decorate or to beautify our homes, is very widely spread. The number of those who employ their otherwise idle fingers during their leisure time in some kind of work is very great, but hitherto this work has been confined to sewing, embroidery, etching, painting, light carving—at any rate, to work where the muscular exertion required is small. This practically excludes any constructive or decorative work which requires to be made out of materials of a hard and enduring nature, but if once the electric motor is pressed into our service, if the electrically-driven shaper or graver needs only to be intelligently directed by the user, the most delicate handed lady could cut and carve out designs in the hardest materials with the same ease and same certainty that she now uses the embroiderer's needle or the etching pen. There is one use to which electrical energy can be applied in very considerable quantities in residential districts. I allude to the production of artificial cold by means of electric motors. You all understand that this is at present done by arranging them to drive an air compressor, and afterwards expanding the compressed and already cooled air into any properly constructed cold room in which it is desired to maintain a temperature sufficiently reduced to store perishable eatables—such as meat, fish, game, and vegetables or fruit—for long periods. Such cold storage would enable each consumer to deal far more directly with the producer than has hitherto been the case; the cost of several daily deliveries of food articles would be practically abolished, and the extravagances and waste of housekeeping would be reduced to the lowest possible limit; in fact, the advantages of such cold storage are so obvious that it is unnecessary to further insist upon them.

There is another development of the use of electricity for motive power to which I think your attention should be directed. The president of the Institution of Mechanical Engineers, in his address to the mechanical engineers in April of last year, drew attention to the efficiency that we claim for electric transmission of power to machine tools, and compared it with the efficiency of existing systems. I have Prof. Kennedy's permission to use his address as a means of carrying this highly interesting problem a step further. He said that, "In any given factory running on the ordinary system there is a large continuous waste of power due to the running of the whole shafting, no matter how many or how few are at work; under such conditions, the waste work in shafts and belts may well be 25 per cent. of the average useful work, and the distribution of total work may be approximately—

"For the useful work	100
"Wasted in belts	25
"Wasted in engine friction	20
	145"

He compared this with an electric transmission as follows:—

Useful work	100
Wasted in motors and dynamos	24
Wasted in leads	2
Wasted in engine friction	20
	146

So that he shows that the two sets of figures are practically the same as to amount of power required. I think that the cases where the comparison would work out on such equal terms would be very rare indeed, and would only be likely to apply to textile or similar factories. In engineering shops, where the time during which each machine tool is standing for the work to be fixed is very large compared with the time that the tool is actually running, I think it would be not too much to say that in most such shops the useful 100 horse-power he gives in his first table might be divided by three, the other losses remaining constant, so that the average useful effect throughout the day is not as 100 : 145, as given by him, but rather as 33 : 78; in other words, the average efficiency, instead of being 68½, would be really about 42; but in such a case, if electric transmission with separate electric motors for each tool be used, the efficiency can remain at 68 as before. Therefore I believe that the cases where electric transmission of power can be substituted with considerable advantage over present systems are far more numerous than Prof. Kennedy's figures would lead us to suppose. It will be noticed that the difference between my assumptions and those of Prof. Kennedy lies chiefly in our estimate of the load factor of each of the tools.

Several times when addressing you here I have used the term "load factor" to denote the ratio which the total useful time during which the appliance is worked discontinuously bears to any given period, whether it be an hour, a day, or a year. As you know, I found myself compelled to investigate this question when dealing with the cost of electrical energy in my paper before the Civil Engineers; but this load factor question has a far wider application. If an attentive observer walks round a factory where machinery of any kind is being used, and takes careful note of the relation of the periods of useful work of each machine to its periods of idleness, he will be struck by the large proportion which these hours of idleness bear to the hours of usefulness. As regards the machines themselves, the only loss caused by these long periods of idleness is that due to the interest on the money invested in them; but in the case of the engines which drive them, or of the transmission devices, such as shafting or belting, in addition to the loss of interest, there are continuous losses due to the waste of power, and cost of attendance that is required to keep them in motion at the required speed during these idle periods.

This matter is of great importance to us electrical engineers, for of all methods of transmission of energy that now exist, none can be worked with so little waste of power during these periods of idleness as electrical transmission. I have already shown this to be the case where the source of power is obtained from an electric supply station, and it is certainly the same in any works where any considerable number of tools are required to be intermittently driven.

One of the chief difficulties that have been met with in replacing the muscular energy of ourselves or of animals by that of the forces of Nature, has been that of providing a variable ratio between the two factors of speed and torque that is necessary if we have to obtain from a constant source of energy the varying duty that we usually demand from our muscles. All our machine tools are provided with a few changes of the speed gear, which forms a clumsy approach to this requirement. I have sought in vain for a short expression to define such a variable gearing, but am obliged to content myself with calling it "Speed torque ratio gear." In all attempts to carry this out mechanically, the change of ratio can only extend through very narrow limits, and at the outside four or five steps in the change of ratio can be given. Mechanical engineers for many years have been looking for such a gearing which will vary the ratio exactly as required, and not by steps. The nearest approach to this has been by two reversed cone pulleys, with a round belt of constant length, which is moved or retained in any desired position by a fork sliding in guides. Quite recently Mr. W. W. Beaumont has introduced a mechanical variable ratio gear, which is a decided improvement; but in my view the first real step which promises to revolutionise our ideas on these matters has been the working out of this problem in the electrical portion of our plant, *i.e.*, in availing ourselves of our really flexible connecting rod, electricity itself.

One arrangement of this kind has been worked out in America by Mr. Ward Leonard. If it is desired to provide from a constant source of energy at the axle of the motor, either great torque at very low speed, or the same energy in the form of reduced torque at the higher speed; this is done by Mr. Leonard by passing the energy through a motor generator, the motor of which may be either an electric motor driven from a central station, or a steam, gas or water engine, but in every case delivering a constant supply of mechanical energy to the spindle of the generator portion, the armature of which is connected by short conductors of low resistances to the motor. If the magnets of the motor are kept supplied with a constant field from a constant source of supply, and the magnets of the generator receive a variable degree of excitation by inserting a rheostat in series with them, so that the field may be varied through wide limits, by commencing with an extremely weak field in the generator, the motor can be started with a large current, giving large torque at low E.M.F.; then as the excitation of the field of the generator is gradually increased, the E.M.F. of the generator and of the motor will also be increased, and at the same time the torque diminished, so as to get the spindle gradually into motion, and the machine driven by the motor steadily brought up to its proper speed.

I give the description of this beautiful electrical gear just as it is given to me, and am told that there are no difficulties found in working it in actual practice; but I feel sure that it is only one of many similar methods by which this variable torque and speed ratio can be worked out electrically, and with a simplicity in the moving parts resembling that of the muscular system of the animal world. The application of this invention to working long lines of railway would appear to get over the great difficulty which would be due to the heavy fall of potential which occurs at the times when large currents are taken by the ordinary train motors whenever a train starts from rest, this difficulty being only slightly reduced by the device of motors arranged in series, and afterwards switching them into parallel. With Mr. Leonard's arrangement, a long line may be worked at a high E.M.F. of 10,000 volts, generated by monophase alternating machinery, transformed at intervals and supplied to sections of the line at an E.M.F. sufficiently low to be easily dealt with —say, 500 volts—but still in the form of an alternating current. This alternating current could be collected from the line and used to work the motor as the arrangement I have just described would allow that this motor should be a monophase synchronising motor, worked at extremely high speed, and having the generator driven by it; the generator and the main motor would be of the continuous current type, and there is no reason why the motor should not be of extremely low E.M.F., and consequently easily made direct acting on the driving axle.

I have described this invention at some length, for, although it may have been noticed by some of you, it has probably escaped the notice of many who are engaged in thinking out the interesting problems of electric traction, haulage, or other uses to which the use of electric power is every day being applied.

We electrical engineers are frequently complimented on the perfection to which we have brought our measuring instruments, and in most cases this praise has been fairly earned, but I think some protest should be made against the very impossible degree of accuracy which is often claimed for electrical measurements. Such claims for accuracy, those more thoroughly conversant with the subject know to be unwarranted; they arise from an incomplete appreciation of the difficulties which attend the making of very accurate measurements of any kind. We often see the efficiencies of the various classes of electrical apparatus worked out to several places of decimals, when it is well known that no instruments exist which could record the measurements to this degree of accuracy. Electrical measuring instruments depend, in the majority of cases, on the accuracy with which they can indicate the amount of the minute forces to which their moving parts are subjected. In order to make them as sensitive as possible, these moving parts must be delicately adjusted or suspended, and the accuracy of the readings depends entirely upon the degree to which the instrument can be depended on to reproduce exactly the same readings under the same conditions as those observed when it was originally calibrated. It is evident, however, that this accuracy can only be maintained if the friction of the parts and their correct position, and the strength of the controlling forces, remain exactly the same as they were at the time of calibration. In practice it is found impossible to guard against minute changes in these conditions; so that, however accurately the instrument of precision may be calibrated in Scotland, the very delicacy of its pivoting or suspension, which are necessary for accuracy, make it quite certain to lose its correct calibration after a journey to London, and no one could swear to the correctness of the readings. The case becomes worse if such instruments have to be used as travelling standards of reference. Take the very common instance of an inspecting engineer going to a maker's works to test the efficiency of a steam dynamo, the passing of which may depend on 1 per cent. of efficiency. In order to simplify this matter, I will suppose that there is no dispute as to the measurements of indicated horse power, but that it is confined to the difference between the electrical readings of the maker's instruments and those of the inspector. One per cent. error in the readings of either current or volts, or ½ per cent. error in the readings of both of them, is sufficient to reject the machinery. How is it possible for an inspecting engineer to avoid dispute? how can he say that he feels more confidence in his instruments than in those of the maker? The balance of probability is that the maker's instruments, having remained *in situ* since their calibration, are less liable to error than the travelling instruments, which may have received shocks during their journey. If, however, the dispute had not been an electrical one, but had turned on questions of size or weight, the size measurements would have been easily dealt with by the ordinary steel rules in the shop, which can generally be depended upon to one part in a thousand; and the weight would have presented no difficulty, as, if an ordinary beam balance were available, it could be adjusted in the presence of both parties, or, at any rate, the positions of the standard weight and of the object to be weighed could be exchanged, so that the mean of the weights thus taken would give the correct result. I have always thought that all important and accurate electrical measurements should be as easily checked and referred to a standard as the measurement of weight can be in the beam balance, but no existing measuring instruments having moving parts can be thus easily checked. For this reason, for the past eight years I have been attempting to reduce all electrical measurements to a balance of electrical forces—that is to say, by referring them to a standard fall of potential obtained on a carefully calibrated slide wire—in other words, the potentiometer. I have occupied much of my leisure time during the above period in perfecting this potentiometer system, which is already well known to most of you. I only mention it here in order to point out that with this instrument there are no moving parts, and that the only calibrated portion—the slide wire—can be subjected to extremely rough treatment without altering the accuracy of the instrument to any material extent. Once this slide wire is accurately divided, and that portion of it on which the sliding contact works is made of equal and even resistance per unit length, and is stretched rigidly over an accurately divided scale, it is almost impossible for the instrument to lose its calibration, short of actually severing the wire; and even if the wire is severed, a new wire can be applied and calibrated without the necessity of sending the instrument home to the maker, or to any standard laboratory, in order to compare it.

Whilst on the subject of electrical measuring instruments, I must not neglect to notice that very beautiful instrument, the bolometer of Prof. S. P. Langley, and its recent developments in the hands of Messrs. Lummer & Kurlbaum. The bolometer is really the most refined method of measuring temperature that has yet been proposed. Its readings are obtained by measuring electrically the varying resistances of a platinum film when submitted to minute changes of temperature. It is, in fact, Siemens's electric pyrometer or Callendar's platinum thermometer in its most complete form.

I should also not fail to call your attention to the splendid work of Prof. Callendar and Messrs. Griffiths & Clark in perfecting the platinum thermometer. By the aid of this instrument, and by electrical means, Messrs. Griffiths & Clark carried out the most recent determination of J, the value of the mechanical equivalent of heat. In my own practice I have found that the ease with which the platinum thermometer can be used in connection with my potentiometer system has given to me the most accurate, sensitive, and convenient methods of measuring temperatures in the various electrical apparatus which I have to examine. Anyone who possesses a potentiometer can take almost simultaneously any desired number of temperature readings by employing a number of platinum coils all made equal in resistance to an external standard with which they have been compared and adjusted at the temperature of melting ice. The external standard must, of course, be of manganin, which at ordinary temperatures has practically no temperature coefficient. If we adjust our potentiometer so that the readings on this standard are equal to 100 on the scale, the readings taken over the various platinum coils that are coupled in series with it will give directly the percentage rise, from which the temperature can be read off on a table calculated from the temperature coefficient of that batch of platinum wire.

I do not know if this beautiful method of measuring temperature is generally known to electrical engineers who are investigating such matters as the changes of resistance due to changes of temperature in insulating materials, the rise in temperature of the various parts of dynamos, transformers under varying conditions of load—in fact, in the everyday quantitative work of the electro-dynamic designer.

I have stated that in my researches I have adhered rigidly to the principle of making accurate electrical measurements by obtaining a balance of E.M.Fs.—in other words, by using a zero method. I should here explain that there are two zero methods—namely, that obtained from the simultaneous balancing of two forces, as in the Wheatstone bridge or any other split-circuit device; the other, by balancing each of the two forces in turn (*i.e.*, the one to be measured, and a standard with which it is to be compared) against a third force, the two comparisons being made as quickly as possible one after the other. This is the zero method that I prefer, as it avoids the very great possibilities of error which I find are likely to arise whenever divided or shunt circuits are used. With this latter method the determination of several falls of potential can be obtained off different portions of the same circuit through which one and the same current flows in series. One can be certain that, apart from the minute variation due to the difference of time, the conditions of current flow are absolutely identical. From my point of view the only permissible use of shunt circuits is in the potential leads attached to the two points, and by means of which the difference of potential is measured; but a circuit through these leads cannot strictly be called a shunt to the main circuit, for, although a small current may be passing through it before perfect balance is obtained on the potentiometer, as soon as such balance is obtained, absolutely no current passes through this potential lead circuit, so that any change in their resistances, or in the resistance of their contact with the standard conductor, does not affect the readings. For accurate measurement of large currents we use sheets or strips of suitable alloys, so as to reduce the correction for change of resistance, due to change of temperature, as far as possible. The copper-manganese nickel alloy, called "manganin," has turned out to be very useful to us in this respect. It has the great advantage of having a falling curve between the temperatures of 30 and 70 Centigrade, and can consequently be compensated by being combined with a metal having a rising curve, in such a way as to produce a standard having no temperature correction necessary between the above limits.

No doubt you will expect me to say a word on the subject of elec-

tric storage. Although comparatively little has been written or said about the improvement in the design and manufacture of the lead secondary battery invented by Planté, yet the progress in its development has been quite as marked, and quite as satisfactory, as that of the dynamo machine or alternator. I do not allude to new patterns of accumulators which claim to be new inventions, but solely to the improvement in detail and in manufacture which has followed on the competitive use of well-known existing forms. No doubt one reason why members of this Institution are not kept as well informed on the development of the storage battery as on other subjects, is that the questions involved, being electro-chemical ones, are extremely complex, and require long periods of time for their thorough investigation. Moreover, I regret to say that a dead set has been made at accumulators by some members of this Institution, who never rise in their places to mention them otherwise than by a sneer. It is curious this should be so. The secondary battery demands as high qualities for its patient investigation as does any other branch of electrical engineering; and those who are never tired of telling us that they cannot see the importance of improving electrical storage, as much as that of any other portions of electrical plant, only show that they have a very incomplete grasp of the requirements of our art. At any rate, if we can judge from cost price, and from cost of upkeep only, the advance in the construction of accumulators during any period—say the last 10 years or last five years—has been quite as rapid as that of the advance of the construction of dynamo-electric machinery. A reference to the price list of makers of dynamos and accumulators will show that this is the case, and from my own knowledge I can state that recent improvements are reducing the cost of maintenance to an equal extent. The study of the proper application of accumulators for electric supply is not confined to the design of accumulators themselves, but to the many adjuncts necessary to use them to the best advantage. The difference between the E.M.F. of charge and discharge has been satisfactorily dealt with by the various "booster" systems that have been introduced during the last two or three years, and the proper proportion which the output of the accumulators themselves should bear to that of the station, and the most economical size of generating unit to charge these accumulators, have also been carefully worked out.

It is probable that most of the early troubles with accumulators were due to the want of knowledge of the necessity for extreme purity in the materials used. These impurities concentrated themselves in the active material on the negative plate, and caused the now well-known phenomenon of self-discharge of the negative plates, which of itself is sufficient to account for the majority of the early breakdowns which at one time appeared to be so mysterious. We know how important it is for dynamo construction to have iron absolutely free from manganese, and copper from arsenic, minute quantities of these, which could hardly be detected by chemical analysis, having the effect of largely altering the permeability of the iron or the conductivity of the copper. No less it is the case that minute quantities of certain metals, such as copper and arsenic, have an equally prejudicial effect in the lead used for accumulators, and the discovery of this effect has had a most important effect on the cost of manufacture and the cost of upkeep.

I feel that I should be failing in my duty towards you if I did not raise a note of warning on a point on which I feel very strongly. Owing to a combination of causes, the chief of which has been the great extent to which public money is now being spent on electrical supply undertakings, the control of large sums raised on the security of the public rates has been placed in the hands of very young engineers whose engineering life and experience has been a very short one. I am afraid that, in some cases, the extent of their responsibility has not been as fully realised by these gentlemen as it ought to have been. Local and special requirements have been insufficiently studied, designs have been hurriedly prepared, and *pros* and *cons* of the various systems which could be used have been inadequately balanced, and I feel great misgivings as to the criticism that will be passed on these hurried designs after a few years have passed. I go further than this: I think that in many cases failure in part or in whole will follow; and so soon as this takes place a reaction will set in, which will damage the interests of our profession almost as much as the speculation in electric light companies' shares in 1882. We all know, or ought to know, that an electric supply system, to be successful, ought to be worked out from beginning to end as a complete scheme, with due regard to the special conditions of the town as to the probable light and power requirements, and to the habits of the people; and that this is a very different thing from the mere preparation of a design for a building containing some plant, for laying a few miles of mains in the principal streets, with variations in the shape of providing power from dust destructors or utilising thermal storage, in order to humour the vagaries of those of the electric lighting committees who fancy themselves engineers. I fear that this Institution is in some degree to blame for this: the papers that have been read, discussions that have taken place, have turned far too often on purely scientific matters, of interest only to the scientific men who took part in them; and that this has thrust into the background the more prosaic matters which must be studied by those who hope to deal thoroughly and economically with the many and varying conditions of electric supply.

I hope these remarks will be taken in the sense that they are intended to be taken. It is even now not too late for those who are already carrying on works to inform themselves more fully than they have hitherto done on what is going on around them, and on the respective merits of existing electrical engineering practice. I know that many of those who are now so engaged, and who are responsible for the designs of the supply works that are now arising throughout the United Kingdom, and many of those who are now on the look-out for such employment, are setting out insufficiently equipped for their task; they have, I fear, studied their subject too much as book students, and have not spent sufficient time on travel and on the careful study of electrical machinery as it exists in England, the Continent, and America. As an engineer intimately connected with the management of several important supply works, I know that the number of young engineers who really attempt to practically examine and study the working of existing supply works is small. If I ask the engineers in charge of any works how often they receive visits, or have really serious inquiries addressed to them on these matters, I am answered that such inquiries are practically not made; in fact, I am afraid that the interchange of ideas, the comparison of experiences in the use of various novel kinds of plant, the exchange of statistics, exists chiefly among us, the older members of the profession, and that, although we are most willing to impart what we know to our younger brethren, we are practically never asked to communicate the results of our experience.

I hope, also, that what I am now saying will not be put down to the natural conservatism or grumbling of an older man dissatisfied with the existing order of things. Think the matter over for yourselves; compare the length of time that you have occupied in your training, and the number of years' experience that you have in your new profession, with that of the engineers employed in other branches of engineering who are put in charge of undertakings of equal importance. However brilliant may be your talents, you cannot hope to acquire that unerring critical faculty that bears of rapid decision between the two methods that offer themselves to you, of dealing with an engineering difficulty, and which was so ably described and put before Section G at the last meeting of the British Association by one of our members—the president of that section, Prof. Kennedy—until you have added years of practical observation to your training as a pupil, or your workshop experiences. I feel sure that Prof. Kennedy will allow me to quote his own words:—"The whole use of college training, of workshop practice, of practical experience, is to provide the engineer later on with the means of critically examining each question as it comes up, of reviewing systematically the *pros* and *cons* of each method of dealing with it, of coming finally, rapidly, positively, to some definite condition, which may then be irrevocably carried out."

I am now addressing the whole body of electrical engineers, old as well as young. None of us are too old to learn and profit from the experience of others; in fact, as I have already said, I find that such interchange of ideas as now exists is far more among the older than the younger members of our profession. This is much to be regretted. It may be partly due to the diffidence or shyness of the young men; but I greatly fear in many cases it is due to their fear that their crude and hastily formed ideas may be adversely criticised. Never, during the 16 years which I have named as the life of our art, have there existed more momentous questions to be solved than at the present moment; and if I can by my words induce a freer interchange of ideas, so that we help one another more than has been done in the past, I shall feel that I have been of some service to the Institution. Such interchange takes place most naturally in the tea room after each of our discussions. I think the time spent in the tea room is very valuable, and is far too short; and I think the practice, recently started by the Institution of Civil Engineers, of prolonging the evening meeting in the form of throwing open several rooms in which may be exhibited models of new instruments of interest, is a good one, and might be with advantage copied by us. This time, after the meeting, is often much curtailed by the length of the discussions, and I hope that you will support me in the chair when I try to shorten the discussion, particularly when it runs away on matters irrelevant to the paper of the evening.

The ideal method of best spending the time of the session is in discussions on the points of most interest to us at the time—*i.e.*, on burning questions which might be started by comparatively short papers, printed and distributed before the discussion, so that the whole evening might be devoted to it. I, for one, hope that we shall have free, fearless, and open discussion on all matters which affect our art. Let us keep away from any imputation of personal motive, but at the same time let us not hesitate to condemn as well as to praise, simply because such condemnation may appear to hurt the commercial interests of A, B, or C; I say, advisedly, "appear;" because honest criticism in most cases is likely to prove to the advantage of A, B, or C, as it may open their minds to matters which they had never had fairly put before them.

After such a long spell of what I am afraid you will consider too plain speaking on my part, I end my address by calling your attention to the diagram on the wall, which shows the combined output, or load, of the London electric supply stations for a night in December, 1894, and which was taken simultaneously for the purposes of this address, and for which I have to thank the engineers of the supply companies. I have not had the opportunity to compare this with the load of any other city in the world, but I fully believe that it will be found to be one of the largest that has ever been drawn out; at any rate, we electrical engineers, with such a diagram before us, can point, at all events, to the very substantial degree of development of supply of electric energy in London.

I have to thank you for listening patiently to what, after all, is a recapitulation of facts which have been already known to many of you; I can only hope that they were not known to others, and that they may be of use to them.

The Northern Society of Electrical Engineers.

Inaugural Address of Mr. Henry Edmunds.

(*Concluded from page* 73.)

Now for our electrical, as apart from our mechanical engineers. The men who by their thought and work have designed our alternate current dynamos, our continuous current machines, our multiphase machines, our transformers, our arc and incandescent lamps, our

measuring instruments and the multitudinous accessories. These men must try to get as far as they can from the traditional millinery of the philosophical instrument maker, and must see that they combine with their electrical requirements the very best mechanical conditions and surroundings. They must also work hand in hand with the mechanic. They must get away, as they are doing, from the sealing wax and brass lacquer, and they must remember that in work of the magnitude that is likely to come on, durability is going to play as important a part as efficiency, and they must not sacrifice to efficiency the many other requirements of practical everyday use. I have not intentionally spoken slightingly of our friends the telegraph engineers. Some of my references have only been to those earlier and respected men whose knowledge was necessarily limited to the electrical portion of their work, so that they did not appreciate the conditions of the mechanical portion. I am glad to say that we have among the members of our society those who are interested in telegraphy and telephony. Telegraphy, more especially as relates to submarine work, could be effectively dealt with by one, who, I regret to see, is not here to night—I mean our respected member and one of our founders, Mr. George Preece—but that being a branch in which the assembled members take little interest, I will not refer further to it. Telegraphy, I may say, seems to be a completed and perfected branch, which may probably continue to grow in bulk, but which will more probably be more or less supplanted by telephony, which has made giant strides during the last few years. Among telephone engineers large and important problems have to be worked out. An ever-increasing number of subscribers means an ever-increasing difficulty in wayleaves and communications. I have no doubt that we shall receive in the future interesting papers from gentlemen connected with this branch, and they will be able to point out to us how they have overcome both their mechanical and electrical difficulties. They will watch with jealousy the introduction of those large power systems for fear of interference by induction and other causes, and engineers will do well to consider here in concert with one another how they can each give and take, how they can each learn something of the conditions and requirements of the other without experiencing either annoyance to themselves or interference with public requirements. Our telephone engineers must not think that they "own the earth" because they happen to have been born first; nor must our electric traction friends think that because they wish to come in as well they can ruthlessly remove all existing systems. There has been during the last few months an animated discussion with regard to these matters, and if the discussion necessary for the removal of these difficulties can be carried on here by papers and debate, I have no doubt that those will be among the things that will justify the existence of this society. We shall have in the near future an enormous advance in connection with electric traction. In 1883 I was interested in being asked by the Blackpool Winter Gardens Company, if I could run a small electrical carriage. I placed this in the hands of my friend, Mr. Holroyd Smith, of Halifax, who afterwards constructed the Blackpool electric tramway. And it is interesting to see that since that date, till practically within the last twelve months, there has been comparatively no advance in this country in connection with electric traction, on the other hand, in 1885 I was in America, and there interested in the Pioneer Company, the Bentley-Knight. I went out to Cleveland to see there the experiments in electric traction, and since then (1888) to the present moment (January, 1895) there has been such an advance that there are now 9,000 miles of electric tramways, as against 4,000 miles of horse tramways. 20,000 electric cars are run, and hundreds of thousands of horse-power are employed in driving the electric plant, and the capital invested amounts to $225,000,000 (£45,000,000). Now one reason among others why we have been held back so much has been the miserable petty jealousies among our own engineers, among men who ought to know better, who would rather that the work of construction should go to America than that it should be done by an old competitor, or countryman. Of course, in these remarks I have no reference to the members of the Northern Society of Electrical Engineers, for fortunately they have not lived long enough to have a history of this kind. I wish this society to avoid these personal petty jealousies. On several occasions on which I have had the honour to address you I have referred to questions of this kind.

And this brings me now to my installing engineer. It is somewhat difficult to define an installing engineer or contractor. I believe that every man who can use a piece of cotton-covered wire, a pair of pliers, and a soldering iron, describes himself as an electrical engineer. We do not want to give limitations to the aspirations of the man who begins at the bottom of the ladder with his wire and pliers; but we do want to give limitations that will secure reasonable productive profits to a business that ought to be carried on well, and not subjected to the ceaseless and unnecessary cutting competition that we experience. In our installing members we ought to have men who have the interests of their work at heart. They have to go into buildings and instal their system of wires and cables, making them as little obtrusive as possible, and to take care there is the least interference with the carrying out of the ordinary work that is being done in those buildings. Now, they have to do, or ought to do, honest work; but I have unfortunately seen many cases in which a competing firm has determined to go for a job and get it at any price, and has then endeavoured to do as little as possible in order to try and do the work at somewhere near the contract price. In the old days we used to get 40s. a light, or point. I do not say that this was not too high, but when we come down to 7s. 6d. a point, either the people in the old time made an outrageous profit or the people in the present time do work that cannot be justified. There is, I am afraid, a tendency for a great deal of "eye-service" in this. As long as the switches will turn on the current to the lamps, and no questions be asked as to the condition of affairs between the dynamo and the lamp, or the wires, joints, and cut-outs, some people are satisfied, always provided they can get their bills paid. But after all this is a very short-lived policy. We must not bring our business into disrepute by cheap and ineffective work. I recollect in America that a manufacturer of cotton goods told me that he had had a large enquiry and was doing a considerable business in China, and that he believed some of his cottons were being imitated and sold under a similar mark by Manchester houses; which, while he considered it very flattering, was a great surprise to him till he looked into it. I myself looked into the question, and found that in this district of Manchester there had been a practice of dressing or loading cottons with certain mineral substances and earths in order to give an attractive finish and a heavy weight, and which could be sold to the unsuspecting foreigner at a much greater profit in close competition, because it was naturally considerably cheaper to load with earth than with cotton. These goods were sent out to China, and poor John Chinaman and his friends discovered that the first shower of rain, instead of glancing harmlessly off his clothes, washed away all the earth in his cotton suit, and left him practically enveloped in a sieve. The Chinese then found that the practice of loading cotton had not then been extended to America, in spite of the proverbial "cuteness" of the Yankee, because, owing to his protective tariffs and other conditions the American manufacturer was able to make a reasonably good article and sell at a comfortable price; and although they commanded a higher value in China, they were preferred to the English article. Thus the Manchester goods got a bad name difficult to recover, and the American got in as maintaining his quality. Now, I am not addressing you as generally being in the Manchester trade; but as we happen to live and work in this district let us be warned by the mistakes of others and take care not to commit them ourselves.

Now, then, to you contractors, see that your work is well done! See that your work can pass muster by our friend the consulting engineer and by our esteemed friend Mr. Heaphy and other representatives of the fire insurance offices. If you do your work honestly and well you will find that it will pay you. You will be able to say that for work bearing the reputation of your name you must have a certain price, and let the men who want to cut, cut, and do as bad work as they please. They will soon either go right out of the trade, or find it is useless to do bad work for nothing. They will see the folly of their ways, and do better work at a profit. It must not be left (as is unfortunately too often the case) to contractors to say, "Well, we do not mind what we get for the work so long as we can vary the tender. We can then make our profit on the extras." This, gentlemen, to my mind is not right.

Now I have gone carefully over the different interests of the society. I have tried to call your attention to our individual selves, and now I want to look at ourselves collectively. As we have seen, we have grown during our first year rapidly and satisfactorily. But it is not sufficient that we should grow simply in numbers. I said that in addition to the practical and technical objects of our society we had another one, the social elements to consider. If this body poses as a purely scientific society, which it evidently does not, we might, in the regions of pure science, almost feel that we could ignore social considerations. But as the bulk of our members are eminently practical, our social relations to each other become important; and it is here I think that this society has a large field for usefulness; and I should say that the introduction of dinners, smoking concerts, excursions and other social gatherings, if judiciously carried out, may be found to be a most useful thing for us all. When men in similar pursuits only meet each other from a business point of view, they are apt to see each other to the worst advantage. I am glad to say that men whom I once did not care to meet because our interests were conflicting have, on further acquaintance, been those I honoured and respected most. You will probably find this to be the case here; and, if instead of the manifold petty jealousies that are apt to be fostered among members of the same profession, you will get into an inner or family circle, recognising that you are members of the same family and have an equal right to live and let live: and that by good feelings of brotherhood, and give-and-take, and not each one going for himself, you may be able to do a vast amount of good in the future. How often would it be useful for men to honestly and honourably get together to discuss certain points and questions of price, policy, and quality of work, rather than only know the price when tenders come out, and the quality when the work is done. It is not as though there were not enough work for all. The extension of the electrical industry is practically unlimited. Lighting, traction, telephony are yet, comparatively speaking, in their infancy. And when we come to such things as electrical transmission of power, electro-deposition, electrochemistry, electric welding, heating, cooking and smelting, we can see the field that can be practically and profitably occupied by everyone connected with this industry. But in order to occupy this field well, we must have a proper recognition of the rights of each other; and I trust that you will receive the remarks that I have made in this address and apply them practically to yourselves. I trust that you will not consider that I have taken advantage of my position as president to give an address which is not to be discussed, and which may appear to be rather in the nature of a homily than of a technical discourse. The scientific and technical discourses must come along in the future. My only wish is to endeavour to lay a proper foundation on which the structure can be built; and I wish it to be that in ten years time, when you hear your then President address you, that those there present may look back with feelings of gratitude and pride to the time when they first became members of the Northern Society of Electrical Engineers.

Electric Organ.—It is proposed to introduce an electric organ, to cost about £1,000, into the west gallery of the Mitchell Hall, forming part of the extension of Marischal College, Aberdeen.

NEW PATENTS—1894.

378. "An improvement in dynamos or electric generators by means of which a constant pressure is maintained under varying speeds." G. E. Fletcher. Dated January 7th.

396. "An improved grid for secondary battery plates." A. Slatter. Dated January 7th.

398. "Improvements in automatic telegraph instruments." H. Whawell. Dated January 7th.

430. "Improvements in magnetised toys and apparatus therefor." C. Appleford. Dated January 7th.

432. "Improvements in electric accumulators or secondary batteries." E. Ageron and A. Fournier. Dated January 7th.

437. "Improvements in and connected with electric arc lamps." J. B. Barton. (Communicated by W. Jandus, United States.) Dated January 7th.

480. "Improvements in electrical measuring instruments." E. S. Shoults and G. Binswanger. Dated January 8th.

497. "Improvements in and relating to electric railways." J. C. Love. Dated January 8th. (*Complete*)

523. "An improvement in lightning arresters." R. Belfield. (Communicated by The Westinghouse Electric and Manufacturing Company, United States.) Dated January 8th.

525. "Improvements in magnetic cut-outs." L. Andrews. Dated January 8th.

527. "An improved galvanometer lamp, stand, and scale." H. F. W. Burstall and J. J. Hicks. Dated January 8th.

530. "An improved electrical current reverser and testing key." R. H. Tonking. Dated January 9th.

531. "Dynamo-machines for producing alternating electric currents of low tension." A. G. Adams. Dated January 9th.

541. "An improved combined electric bell and indicator." A. Eckstein and R. P. Eidsforth. Dated January 9th.

545. "Improvements in electrical switches." C. M. Dorman and R. A. Smith. Dated January 9th. (*Complete.*)

546. "Ignition and gas-generating body for explosive engines rendered incandescent by an electric current." A. Niemczik. Dated January 9th. (*Complete.*)

563. "Process for compressing and moulding electrolytically obtained metallic precipitates." I. Klein. Dated January 9th. (*Complete.*)

613. "A mode of giving warning by means of electric bells, of the approach of trains at level crossings on railways." T. Ireland. Dated January 10th.

620. "Improvements in electrical apparatus for protection against fire." W. Jeffery and F. Taylor. Dated January 10th.

632. "Improvements in galvanic or primary electric generators." E. Ageron and A. Fournier. Dated January 10th.

656. "An automatic clutch-sustaining device for brackets, pedestals, or other fixed or movable supports for electric light lamp and other purposes." J. E. Preston. Dated January 10th.

671. "Improvements in magnetic cut-outs." L. Andrews. Dated January 10th.

684. "An improvement in and relating to lamp-holders for incandescent electric lamps." G. C. Cannon. Dated January 11th.

687. "An improvement in machines for transforming continuous or direct currents of electricity and for other purposes." G. Cheffey-James and H. P. Ward. Dated January 11th.

712. "Process for the electrolytic extraction of nickel and cobalt from ferruginous raw materials." L. Munzing. Dated January 11th.

736. "Electric alarm detector and valve for chlorine gas." R. W. Hill. Dated January 11th.

737. "Production of aluminium and generator of electricity." R. W. Hill. Dated January 11th.

807. "A process for the electrolytic decomposition of alkaline chlorides." W. Siepermann and H. Riegermann. Dated January 12th.

816. "Production of gaseous ammonia by electricity." R. W. Hill. Dated January 12th.

817. "Production of nitric acid by electricity." R. W. Hill. Dated January 12th.

818. "Improvements in phonographs." V. Lahola and A. Sachs. Dated January 12th.

825. "Improvements in arc electric lamps." J. J. Mann and L. Hermand. Dated January 12th.

831. "Improvements in and relating to electric arc lamps." R. C. Quin and B. Symmons. Dated January 12th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1893.

18,403. "Improved means of inter-communication by telephone." J. J. Mann. Dated October 2nd. The inventor makes use of a complete metallic circuit, but breaks the same in four places, two at the exchange and two at the subscriber's instrument, and by taking each of the wires at each of these points to earth, he so makes use of three distinct circuits; namely, the metallic circuit itself, the one side of the metallic loop earthed at both ends, and the other side of the metallic loop earthed at both ends. The two latter circuits can be utilised for working the switch at the exchange, and the metallic circuit for speaking. 1 claim.

23,669. "Improvements in electrolytic vessels for primary and secondary batteries or accumulators, and other processes of electrolytic decomposition and electrolytic action, such as for the extraction of metals from their ores, electro-depositions, and the like." P. Schoop. Dated December 8th. Consists in bringing about a definite flow or circulation of the liquid from the top of the vessel to the bottom, and thence to the top again. 3 claims.

23,687. "Improvements in telegraphy, and in the means employed for perforating tapes used for this purpose." P. B. Delany. Dated December 8th. For transmitting electric impulses to a line wire, the inventor employs a travelling strip of paper having along it two parallel lines of perforations, and two pairs of fingers or brushes, bearing upon the paper one pair above and the other below it. The ends of the fingers or brushes are made to come opposite to one another, and to bear upon the paper on the lines on which the perforations are made. 7 claims.

23,883. "Improvements in switches or relays for use with alternating currents, also applicable to vibrators." H. Aron. Dated December 12th. Consists in arranging two magnetic fields vertically upon each other, and placing a closed copper ring within said fields, the plane of the turns of said ring being so located that the lines of force of one of the said fields are directed vertically to the said plane, while the lines of force of the other field are directed parallel to the same. 3 claims.

24,254. "Automatic electric switch." F. H. Nalder, H. Nalder, C. W. S. Crawley, and A. Soames. Dated December 16th. Relates to an automatic switch for the purpose of joining together two circuits, A and B, when the electromotive force of A is a predetermined amount in excess of and opposed to that of B, and disconnecting them when the electromotive force of A is in the same direction as that of B, or opposed to and equal to it, or less than it by any predetermined amount. 2 claims.

24,414. "An improved means of underground current supply for electric railways." W. P. Thompson. (A communication by A. Rast, of Nuremberg.) Dated December 19th. Consists of a centre rail in sections insulated one from another, with each of which a fully closed box is connected in such a way as to be watertight. An electro-magnetic apparatus is contained in this box, and is connected with the main conductor by means of a supply wire, which is watertightly inserted into the box. The electro-magnet consists of a coil, the wire of which forms a continuation of the supply wire. The armature of this electro-magnet consists of an iron core vertically supported in the coil, which core carries at its upper end a metal brush, curved with its two ends upwards, which is connected with the fixed coil by means of a flexible connection. Between the upwardly curved arms of this brush or circuit closer, a piece of iron in the form of a screw head or nut, or the like, is fastened. On the under side of the motor carriage, there are arranged a permanent magnet and a contact brush, and these slide together, with the carriage, over the centre rail sections. 2 claims.

24,951. "Improvements in electrical measuring instruments." F. H. Nalder, H. Nalder, C. W. S. Crawley and A. Soames. Dated December 28th. Consists of a pivoted coil or loop conveying a current moving in a field of force.

1894.

1,776. "Improvements in electric arc lamps." W. A. Walton. Dated January 27th. Relates to improvements in the mechanism for feeding the carbons in electric arc lamps, also for automatically striking the arc by separating the carbons when the electric circuit is completed. 2 claims.

4,170. "Improvements in alternating current electric motors." W. P. Thompson. (A communication by C. S. Bradley, of America.) Dated February 27th. Consists in providing the motor with the rotary field operating upon a common secondary element, and providing in the secondary circuit, which polarises such element two paths for the current, one of which will be selected when the poles of the rotary fields occupy the same inductive relation to the secondary circuit, and the other of which will be selected when the poles occupy a different inductive position with reference to the secondary circuit. 4 claims.

4,171. "Improvements in alternating current electric motors." W. P. Thompson. (A communication by C. S. Bradley, of America.) Dated February 27th. Consists in providing two secondary circuits mounted on the same shaft, one of high resistance, and the other of low resistance, and placing in co-operative relation thereto an inducing circuit adapted to develop a rotary magnetic field, said inducing circuit being adjustable, so as to be brought into active relation to either of the secondary circuits. 2 claims.

5,754. "An improvement in electrical arc lamps." W. H. Lauder. Dated March 20th. Consists of a piece of soft iron so arranged in the shunt solenoid as to act attractively on the shunt core, and intensify the pull of the shunt against the series core when the resistance of the arc arrives at its normal. 3 claims.

11,861. "Improvements in electric belts." H. H. Lake. (Communicated from abroad by E. M. Miles, of Chicago.) Dated June 19th. Relates to that class of devices now generally known as "electric belts," in which an electric battery is applied to and carried by a belt adapted to be applied to the person, and provided with suitable devices and connections for the purpose of transmitting continuous current to different parts of the person. 7 claims.